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INDUSTRIAL LINKAGES: A CASE STUDY

by

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The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies and Research for acceptance, a thesis entitled "Industrial Linkages: A Case Study," submitted by Dimitri M. Sakellariou in partial fulfilment of the requirements for the degree of Doctor of Philosophy.

ABSTRACT

The purpose of this dissertation is to study and analyze industrial linkage effects considered to be important for economic development.

Canadian industries having such effects are identified and classified on the basis of indexes that measure these effects.

The Canadian classification is subsequently compared to similar classifications in other countries in order to observe possible similarities or differences in such linkage effects.

In order to examine the constancy of linkage effects over a period of time an intertemporal comparison will be made in the case of Canada using data of two specific years.

The study makes use of the two available Canadian input-output tables of the countries with which Canada is compared.

The treatment of the various parts of the thesis is briefly outlined in the introductory chapter where the sequence of the chapters is also indicated.

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CHAPTER I

INTRODUCTION

It has been generally argued in recent literature that the introduction of certain industries in an economy helps to initiate the process of economic development and the diversification of the industrial structure in it and that, therefore, a substantial part of investment should be made in such industries.[1]

The main characteristic of these industries is the possession of strong "linkage effects," where the term means that these industries are important sellers to or buyers from the rest of the industrial system. In both cases such industries are expected to increase economic activity in their area by virtue of the external economies they provide.

If, for example, a strongly linked industry is a buyer of inputs, it increases the demand for the type of inputs it uses and thus makes it attractive for a producer of such inputs to establish himself near the newly created market. In this case the buyer industry is considered to possess "backward" linkage effects.

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[1] H. O. Hirshman, The Strategy of Economic Development (New Haven and London: Yale University Press. Fourth printing, July 1963). See also, P. N. Rasmussen, Studies in Inter-Sectoral Relations (Amsterdam: North Holland Publishing Company, 1957).

If a strongly linked industry is a seller of inputs to other industries, it is expected to invite user industries in the area. The assumption is that such user industries would be interested in reducing transportation costs for their inputs or avoiding price fluctuations and import restrictions in cases where these inputs are produced abroad.

In such a case the seller industry is expected to exert "forward" linkage effects on customer industries.

Expectations such as these have been justified, at least in some cases, by empirical work. Thus Charles E. Richter in his study of "The Impact of Industrial Linkages on Geographic Association" has found that there is a strong correlation between the strength of linkage effect and regional clustering of industries.[1]

Such a pulling effect of strongly linked industries makes them important agents for initiating and augmenting the industrial network in their area.

This study is an attempt to identify empirically the strongly linked industries of the Canadian economy. The results of this investigation will be compared firstly with available data from other countries and secondly with Canadian data obtained in a different time period.

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[1] Charles E. Richter, "The Impact of Industrial linkages on Geographic Association," Ph. D. dissertation, University of Illinois 1968, pp. 33-70.

The first comparison will show the extent to which linkage effects of Canadian industries are similar to those of corresponding industries in other countries. The second will reveal the constancy, or lack of it, of such effects in Canada over a certain period of time.

On *a priori* basis linkage effects are not in general expected to be the same in different countries nor even stay the same within the same country.

Variations in factor endowments, differences in the composition of final demand and levels of income, variations in the scale of production among countries, all contribute to make for a change in the structure of production and hence in the linkage effects found in these countries.

On the other hand, similarities in such variables could produce fairly similar linkage effects among countries.

To the extent that Canada's technology is expected to be strongly influenced by that of the United States' and to the extent that factor endowments, levels of income, and consumers' tastes are not likely to be much different than those south of the border, the structure of production in general and the linkage effects in particular are expected to have a high correlation to those of the United States.

To the extent, however, that Canada's export sector constitutes a greater proportion of its national output than is the case in the United States, Canada's structure of production is expected to present certain similarities

with that of countries that depend relatively more on foreign markets than does the United States. If for example, a certain product of a primary or intermediate state of processing is exported instead of being further processed by one or more other industries in the country, the industry producing it will appear to have (due to the way this effect is measured) a weaker forward linkage effect than would have been the case had this product been processed locally. To this extent therefore Canada is expected to show different linkage effects in certain of its industries than those of similar industries in the U.S. On the other hand it is expected for similar reasons to show linkage effects that are comparable to countries that depend on foreign markets as much as Canada does.

In order to identify the strongly linked industries of the Canadian economy, this study will make use of methods based on Leontief's open input-output model. Specifically the study will follow methods proposed by Chenery and Watanabe[1] on the one hand, and by Rasmussen[2] on the other.

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[1]H.B. Chenery, and T. Watanabe, "International Comparisons of Structure of Production," Econometrica XXVI (October, 1958), pp. 487-521.

[2]P.N. Rasmussen, op. cit.

The Chenery Watanabe method consists of measuring the degree of interdependence of various industries by computing (a) the proportion of their total output that does not go to final demand, including export demand, but to other industries, and (b) the proportion of their inputs that represents purchases from other industries in the national system and from imports.[1]

The first of these two measures can be taken to represent the forward linkage effect, while the second can be considered a measure of the backward linkage effect.

These measures however, do not give a complete picture of the linkage effects possessed by an industry. They only show the direct effects of an increase in the activity of an industry on the supplying and buying industries. They do not show the impact on the whole economy which results from the now increased demand for inputs of the industries supplying the sector in question or the impact that results from increased supply of inputs from industries buying from that sector.

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[1]The statement concerning imports is valid since we are interested to find the type of industry that by virtue of its strong backward linkage will increase demand for its inputs sufficiently so that import substituting industries will find it profitable to produce the inputs that were previously imported by the buying industry. This statement, however, is qualified in subsequent chapters where for the sake of comparison of the linkage effects handling of imports must be treated in a uniform fashion between countries and between time periods.

In order to take this impact into consideration the Rasmussen method will be used. The method uses linkage measuring indexes that are based on the inverse of an input-output matrix and which therefore makes it possible to measure both the direct and the indirect effects of an increase in the activity of any one industry on the whole economy. Such indexes are, therefore, more comprehensive than the first variety.

A classification of industries based on the magnitude of their "backward" and "forward" linkages would produce a list of industries that have the strongest effects on others. Such a classification however, does not, as it will be seen, show patterns of interdependence. That is it does not show whether a sector buys from one, a few or most other sectors.

Finding such a pattern could help us construct an hierarchy of industries starting from those whose output goes entirely to final demand and whose inputs come from other industries, and ending in industries that buy very few inputs from others but sell their outputs to other industries and to final demand. Industries located between these two extremes will be buying their inputs from those located below them in this hierarchy and will be selling their outputs to industries located above them. The

industries selling only to final demand could be considered as "last" industries, while those that buy nothing or very little from others could be called "first" industries.

This hierarchy is in effect a cataloguing of industries with those showing strong "backward" but weak "forward" linkage effects located at, or close to, the top of the hierarchical pyramid while those having weak "backward" but strong "forward" effects located close to its base. In contrast to other classifications, such cataloguing of industries shows which industries buy from which and which sell to which. In other words, patterns or directions of flows could be easily detected with the help of such a classification of industries.

These patterns are basically a reflection of the linkage effects of industries and therefore a reflection of the production structure of the economy.

If production structures are different among countries, these patterns could also be expected to be different and vice-versa.

This study will attempt to find the kind of patterns that exist in the Canadian economy. Specifically the study will attempt to find whether the Canadian interindustry flows fit into a one-way sequence such as, for example, the

sequence of raw cotton, textiles, clothing, or whether they are mainly of the circular type like coal, steel, mining equipment, coal.

The results will then be compared with those found in other countries to see whether technological or other variables cause similarities in such patterns.

A comparison will also be made of Canadian flow patterns for two different periods of time in order to observe the stability of such patterns.

The international comparison will make use of data available from the Chenery Watanabe study and will include Canada on the one hand and the four countries studied by the two authors.[1]

For the intertemporal comparison use will be made of the two available Canadian input-output tables, namely those of 1949 and 1961.

The methods by which linkage effects and flow patterns will be examined are described in Chapter II. Chapter III contains and analyzes the empirical findings of the international comparison. The methodological and statistical problems involved in intertemporal comparisons are discussed

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[1]The four countries are Italy, Japan, the U.S. and Norway. See H.B. Chenery and T. Watanabe, *op. cit.*

in Chapter IV. Chapter V contains and analyzes the empirical finds of the intertemporal comparison while the concluding Chapter VI summarizes and comments upon the various conclusions drawn from this study.

Appendix A describes the aggregation of sectors necessary in order to make the input-output tables more comparable. Various definitions such as "industry," "establishment," etc. are also given in the appendix. Appendix B is a compilation of tables containing basic data for the study.

CHAPTER II

FRAMEWORK FOR THE COMPARISONS

Before proceeding with the comparisons of production structure mentioned in Chapter I, it is instructive to look first at the conceptual framework on which comparisons could be based. This chapter discusses such a framework. It begins by reviewing the basic input-output theory and proceeds to discuss indexes that may be suitable for the measurements of structural differences.

1. Input-Output Models

In the real world a one-way sequence such as cotton-textile-clothing, is a rare phenomenon. The rule is rather one of circular relations such as coal-steel-mining equipment-coal. The rule, in other words, is one of industrial interrelationships or interdependendences. For the production of coal, iron is needed, for the production of iron, coal is required. In general, goods such as iron, coal or chemicals e.g. are produced by means of a primary factor such as labor or capital and by means of other inputs such as coal, iron, etc.

To take account of such interdependences, input-output models have been developed that permit the tracing and measurement of the flows of inputs and outputs between the various sectors of the economy. Most such models are

based on W.W. Leontief's original work and all depend on the technological inter-relationships of the productive sectors of an economy.[1]

An input-output model divides the economy into a number of sectors or industries. Each sector, in addition to primary factor requirements such as labor, is considered to buy inputs from other sectors and to sell its output to other sectors and, in the case of an "open" model, to autonomous sectors which have no output. Such autonomous sectors represent "final demand" and are not explained by the model. Where the model is of the "closed" type, no autonomous sectors exist. In such (closed) models consumers, government, foreign trade and other components of final demand are treated as sectors that consume the outputs of other industries in order to produce their own outputs consisting mainly of labor, government, and other services. All such consumptions are, in this case, explained within the model in the course of determining the output levels of these industries. By way of an example of an open model, which is the model used throughout this study, one can imagine an oversimplified economy where there are only three industries; agriculture, manufacturing and services. Each requires a primary factor, e.g., labor, in its productive process and each buys inputs from the other two industries.

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[1] Wassily W. Leontief, <u>The Structure of Americans Economy 1919-1929</u>, first edition (Cambridge, Mass., 1941).

Table 2.1 is a picture of this simplified economy. The elements in each row of the table show what happens to the output of the sector that appears on the left-hand side of the table. The fifth row shows how the primary input is distributed among the three industries.

The first row total shows that the service output totals 175 units per year. Of this total 10 units are absorbed by the sector itself, 15 units are required as inputs by the agricultural sector, while 80 units go to the manufacturing sector. The total destined for further processing totals 105 units. The remaining units are absorbed by the autonomous sectors of "final demand."

The role of a sector as a user of inputs is shown by the column in the table. Thus column A shows the agricultural sector as a purchaser of inputs. The total purchased from all industries is 50. The remainder of 160 units consists of primary inputs. These primary inputs represent the value added in this sector and consist of direct payments to primary factors (labor, land or capital).

In this example the total value of output of each good or service is equal to its total demand or total use. Such would not have been the case had imports been included in the model. Total use may thus exceed total output of that good or service by the amount of it that is imported.

An input-output model can in general be expressed by two systems of equations. One concerns the rows of the

TABLE 2.1[1]

INTERINDUSTRY ACCOUNTS

Producing Industries	Using Sectors			Total Intermediate Use W_i	Final Demand Y_i	Total Demand Z_i
	S	A	M			
Services	10	15	80	105	70	175
Agriculture	0	15	100	115	95	210
Manufacturing	5	20	140	165	200	365
Total Purchases (U_j)	15	50	320	385		
Primary Inputs (V_j)	160	160	45		365	
Total Output (X_j)	175	210	365			750

[1] Table 2.1 is based on Table I of H.B. Chenery and T. Watanabe, op. cit., p. 490.

table and states that for each commodity total supply is equal to total demand, which consists of intermediate demand plus final demand.

Using the symbols in Table 2.1 such an equation can be written as

$$Z_i = M_i + X_i = \sum_j X_{ij} + Y_i = W_i + Y_i \quad (i=1,2, \ldots n) \qquad (2.1)$$

where the new symbol M_i represents imports of commodity i.[1]

The second equation concerns the columns in Table 2.1 and expresses the fact that total production in each sector is equal to the value of intermediate inputs (inputs purchased from other sectors) U_j, plus the value of primary inputs, or value added V_j.

$$X_j = \sum_i X_{ij} + VA_j = U_j + V_j \quad (j=1, 2, \ldots n) \qquad (2.2)$$

Under Leontief's assumption that each input X_{ij} is required in fixed proportion to output X_j one can write

$$X_{ij} = a_{ij}\, X_j \qquad (2.3)$$

where a_{ij} represents the non-negative technological coefficient showing the requirements of the i-th input needed to

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[1]Equations 2.1 to 2.7 are in the form used by H.B. Chenery and P.G. Clark. H.B. Chenery and P.G. Clark, Interindustry Economics. (New York: John Wiley & Sons, Inc., 1967), pp. 17-25.

produce a single unit of ouput of industry j.

Substituting (2.3) into equation (2.1) and re-arranging terms we get a balance equation for each commodity

$$X_i - \sum a_{ij} X_j = Y_i - M_i \quad (i=1,2, \ldots n) \qquad (2.4)$$

It is not unusual in such a system of equations to consider imports as dependent variables. It could, for example, be assumed that the level of imports M_i is a function of the total supply of a commodity and hence a function of the level of domestic production of that commodity X_i. This assumption is made in construction the 1961 Canadian input-output model.[1]

If we also make the assumption that this function is linear we can write

$$M_i = \overline{M}_i + m_i X_i \qquad (2.5)$$

where M_i represents autonomous imports and m_i can be considered as an import coefficient.

Combining (2.5) and (2.4) we get

$$(1 + m_i) X_i - \sum a_{ij} X_j = Y_i - \overline{M}_i \quad (i=1,2, \ldots n) \qquad (2.6)$$

where $\overline{Y}_i = Y_i - \overline{M}_i$ = total autonomous demand.

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[1]Dominion Bureau of Statistics, The Input-Output Structure of the Canadian Economy 1961, (Ottawa: The Queen's Printer, 1969), pp. 141-144.

This total autonomous demand equals the final demand Y_i whenever autonomous imports are zero.

A usual problem to which the input-output systems (2.6) can be applied is one in which the Y_i's are specified and the X_i's are to be determined. This involves solving a system of n simultaneous equations in n unknowns. The solution can then be written in the form

$$X_i = r_{i1}\,\overline{Y}_1 + r_{i2}\,\overline{Y}_2 + \ldots + r_{in}\,\overline{Y}_n \quad (i=1,2\ldots n) \quad (2.7)$$

where r_{ij} is a new set of constants derived from the original parameters a_{ij} and m_i. If for example, the original set of equations (2.6) was to be written in matrix form such as $(I + M - A)\,X = Y$ then the r_{ij}'s are elements of the inverse of this matrix, i.e. they are elements of matrix $X = (I - M - A)^{-1}Y$.

This inverse form of the matrix, or its equivalent form (2.7), is known as the "general solution." The coefficient r_{ij} indicates the amount of commodity i that must be produced to satisfy a final demand of 1 in sector j.

The input-output model described so far was followed closely in the construction of the 1949 input-output table for Canada.[1] This was not the case however with the 1961

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[1]Dominion Bureau of Statistics, The Interindustry Flow of Goods and Services, Canada 1949, (Ottawa: The Queen's Printer, 1956).

Canadian model which differs in many respects from the above description. The 1961 model will be discussed in Chapter IV.

2. Indexes for the Measurements of Industrial Linkages

Based on the above input-output framework a number of indexes may be constructed that could be used for the comparisons suggested in Chapter I.

The problem at hand is (a) to construct such indexes that would identify the highly linked industries and (b) to use these indexes in order to examine whether or not the linkage effects of Canadian industries are similar to those of the countries with which Canada is compared and whether or not such effects as have been found for one period are similar to those in another.

A number of indexes based on the input-output model exist in the literature today. Most of these indexes however have been constructed mainly to study the structural change in an economy over a period of time or to make comparisons of the structure of one economy with that of another. These however are much too general comparisons for our purpose. What is of interest here is the examination of structural differences, if any, that may exist among the highly linked industries. This being the case, it is necessary to look for indexes that could be subjected to a meaningful interpretation with regards to development problems. Such indexes will now be discussed.

Looking at the three sectors of Table 2.1 we can see

that each sector plays a double role, that of a purchaser of inputs from the other two sectors and from the primary input sector, and that of a seller of inputs to the other two sectors.

The extent to which each sector depends on the other two for its intermediate (as opposed to primary) inputs can be measured by the ratio of its purchased intermediate inputs U_j, to the value of its total production X_j. Similarly the ratio of demand from the other two sectors for inputs produced by sector i,e.g., to the total demand by the economy for the products of that sector (sector i), measures the extent to which the product of sector i is used as an intermediate input by the other two sectors.

The first ratio can be considered as a measure of the "backward" linkage of an industry, say industry j, and measures the economic effects that this industry exerts on the sectors that are its suppliers. This ratio shall be indicated by the small letter u_j, so that $u_j = \frac{U_j}{X_j}$.

Similarly the second ratio can be considered as a measure of the "forward" linkage of, say, industry i and measures the importance of industry i with regard to the sectors that buy their inputs from it. This index shall be indicated by the small letter w_i, so that $w_i = \frac{W_i}{Z_i}$.[1]

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[1]The indexes u_j, w_j used here as measures of linkages have been first considered by H.B. Chenery and T. Watanabe who used them as measures of the degree of interdependence of a sector. H.B. Chenery and T. Watanabe op. cit., p. 492.

The higher the value of these indexes are, for an industry compared to other industries, the more important is that first industry supposed to be in the role of attracting other industries. The more an industry depends on other industries for its inputs, for example, the bigger the market it provides for the products of these industries and the stronger is expected to be the incentive for their establishment in the area. It is assumed here that the buying industry's size is large enough so that the market it provides is considered profitable by a potential supplier.

These two indexes of interdependence however, useful as they are, measure only the direct links between an industry and those that supply and buy from it. They do not measure the indirect effects that an increase in production of industry j has on those industries that supply the industries that supply j with inputs, or those industries that buy from the industries that buy their inputs from industry i. One must look therefore for some indexes in addition to those suggested by Chenery.

A more comprehensive measure of a "background" linkage can be obtained by considering the inverse of an input-output matrix. Since by inverting a matrix it is possible to measure the direct and indirect repercussions

of an increase in the output of any one industry on the other industries of the economy, indexes derived from the inverse matrix are more inclusive. Such indexes have been thought of and used by the Danish economist P.N. Rasmussen.[1] The following is a description of those indexes that are useful in the present study.

Let Z_{ij} be the elements of matrix Z which in turn is the short hand expression of the inverse matrix $[I-A]^{-1}$ Element Z_{ij} in matrix Z represents the increase in output in industry i per unit increase in final demand for the products of industry j. The sum of the column elements $\sum_{i}^{n} Z_{ij} = Z_j$ represents therefore, the total increase in output from the whole system of industries needed to satisfy an increase in the final demand for the product j by one unit. Similarly the sum of the raw elements $\sum_{j}^{n} Z_{ij} = Z_i$ represents the increase in output in industry i which is necessary to satisfy a unit increase in the final demand for the product of each industry.

If we now take the average of the elements in column j i.e. $\frac{1}{n} Z_j$ (j=1, 2,3,. . .n), we have a measure of the direct and indirect increase in output that must be supplied on the average by any one industry if final demand for the product of industry j increases by one unit. Similarly the average $\frac{1}{n} Z_1$ (i=1,2,. . .n) can be thought of as a measure of the increase in output of industry i needed to satisfy a

[1]P.N. Rasmussen, <u>op</u>. <u>cit</u>., pp. 133-140.

unit increase in final demand for the product of any one industry in the system.

In order now to derive the indexes that will be useful for interindustry comparisons, the above averages should be normalized. That is they should be expressed as a fraction of a common total in order for them to be comparable. This is done by relating them to the overall average $\frac{1}{n^2}\sum_j^n \sum_i^n z_{ij}$ which can be simplified to $\frac{1}{n^2}\sum_j^n z_j$ or $\frac{1}{n^2}\sum_i^n z_i$[1].

The needed indexes are then

$$D_j = \frac{\frac{1}{n}z_j}{\frac{1}{n^2}\sum_j z_j} \qquad (j = 1, 2, \ldots n) \tag{2.8}$$

and

$$S_i = \frac{\frac{1}{n}z_i}{\frac{1}{n^2}\sum_i^n z_i} \tag{2.9}$$

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[1]Since $\sum_i^n z_{ij} = z_j$ by definition and $\sum_j^n z_{ij} = z_i$ also by definition, it follows that the denominator of (2.8) and (2.9) end up to be the same scalar.

When D_j is greater than one ($D_j > 1$) it means that any one industry of the system, chosen completely at random, will need a comparatively large production increase to satisfy a unit increase in the final demand for the product of industry j. In other words a $D_j > 1$ indicates that industry j draws heavily on the system of industries. The opposite is the case if $D_j < 1$. This index describes the extent to which an increase in final demand for industry j's product is dispersed throughout the system of industries. Thus it can be considered an index of the "power of dispersion" for industry j. In the same way when index S_i is greater than one ($S_i > 1$, it means that industry i will have to increase its output more than other industries for a given increase in demand for the products of an industry chosen at random and vice-versa for $S_i < 1$. This index therefore indicates the extent to which industry i is sensitive to an expansion in the rest of the industrial system. In this sense it can be considered an index of the "sensitivity of dispersion" for that industry.

The D_j, S_i indexes, though more inclusive than the simple u_j, w_j indexes, still do not tell the whole story. A certain industry may for example, have a high "dispersion power" meaning that it draws heavily from other industries, but it may be that it draws very heavily from some industries but rather lightly or not at all from others. The industry in other words, does not draw evenly from the rest of the industries but it specializes on the output of some

industries only. Similarly a certain industry may show high "sensitivity of dispersion" and yet not all other industries in the system draw from it. In other words the high value of the S_i index may be caused by a heavy drawing from industry i but this drawing comes from only one or a few other industries and not from all industries.

To take such cases into consideration supplementary indexes are needed. What is needed here is some measure of variability such as the variance or standard deviation of a distribution. Since we are concerned with the distribution of Z_{ij} we would use the standard deviation of that distribution as the needed measure. Hence

$$V_j = \frac{\sqrt{\frac{1}{n-1} \sum_{i}^{n} (Z_{ij} - \frac{1}{n} \sum_{i}^{n} (Z_{ij})^2}}{\frac{1}{n} \sum_{i}^{n} Z_{ij}} \quad (j = 1, 2, \ldots n) \tag{2.10}$$

This standard deviation can be taken as an index showing the extent to which industry j draws evenly on the system of industries. The smaller the value of this index is, the more evenly industry j draws from the system. A large V_j means that industry j draws more heavily on some industries only.

Similarly assuming that the j elements of a raw i are normally distributed around their mean $\frac{1}{n} \sum_{j} Z_{ij}$, we have the needed measure of variability of the elements of that raw

$$V_i = \frac{\sqrt{\frac{1}{n-1}\sum_j^n \left(Z_{ij} - \frac{1}{n}\sum_j Z_{ij}\right)^2}}{\frac{1}{n}\sum_j Z_{ij}} \qquad (i=1, 2, \ldots m) \quad (2.11)$$

This index shows to what extent the system of industries draws evenly on industry i. The lower the value of this index the more evenly the system of industries draws on industry i.

Another measure that is used in the present study is that referred to by H.B. Chenery and T. Watanabe,[1] as the "absolute column measure." With the help of this index we can examine whether similarities are greater in some types of production than in others. In order to examine structural similarities in production in the same industry between two countries, we can compare input coefficients industry by industry. This is done by summing the absolute differences in all the coefficients in each column and by taking a ratio of this total to the average total interindustry purchases of that industry. The more similar the structure of production in the countries compared, the smaller will the ratios obtained be. This ratio is expressed algebraically as

$$\gamma_j^{\alpha\beta} = \frac{\sum_i |a_{ij}^{\alpha} - a_{ij}^{\beta}|}{1/2 \sum (a_{ij}^{\alpha} + a_{ij}^{\beta})}$$

[1]H.B. Chenery and T. Watanabe, *op. cit.*, pp. 504-505. A similar measure is used by Leontief, for single coefficients, in W.W. Leontief, and others, *Studies in the Structure of the American Economy*, (New York: Oxford University Press, 1953), pp. 17-52.

where $\gamma_j^{\alpha\beta}$ is the "absolute column measure"

a_{ij}^{α} is the input coefficient in country α

a_{ij}^{β} is the input coefficient in country β

For these column comparisons it is more appropriate to disregard the sign of the difference in coefficients since each coefficients refers to a different commodity and errors are not compensating. If the inputs are completely uncorrelated, between the two countries, the index will have a value of 2.0. If on the other hand the correlation is perfect the value of the index is zero. This can be seen by considering any one of the two extreme cases. In case of complete lack of correlations of inputs as for example, where $\sum_i a_{ij}^{\alpha} = 0$ and $\sum_i a_{ij}^{\beta} = 1$ (or vice-versa), the absolute difference $\sum_i | a_{ij}^{\alpha} - a_{ij}^{\beta} | = 1$ and so will be the sum $\sum_i a_{ij}^{\alpha} + \sum_i a_{ij}^{\beta} = 1$. But then the ratio $\dfrac{2\sum_i | a_{ij}^{\alpha} - a_{ij}^{\beta} |}{\sum_i (a_{ij}^{\alpha} + a_{ij}^{\beta})} = 2.$

In the case of perfect correlation the absolute difference $\sum_i | a_{ij}^{\alpha} - a_{ij}^{\beta} |$ will equal zero thus making $\gamma_j = 0$. Formally then, one can say that the range of variations of γ_j is the closed interval $|0-2|$.

In the case of intertemporal comparisons, this index could be used to examine whether structural changes in some industries are larger or smaller than changes in other industries. In this case, a_{ij}^{α} could be regarded as the input coefficient in a certain period while a_{ij}^{β} as the

input coefficient of the base period. If the inputs have a high correlation indicating very little change over the period examined, the index will have a value close to zero. If on the other hand the change in coefficients is high the value will be closer to 2.

CHAPTER III

INTERNATIONAL COMPARISONS OF INDUSTRIAL LINKAGES

This chapter will firstly examine the strength of the linkage effects of Canadian industries and secondly will compare these effects with these of corresponding industries in the other countries chosen in this study.[1]

The purpose of the comparison is to show the extent to which linkage effects of Canadian industries differ from or are similar to those of the other countries.

Where such effects differ, the reasons for the differences will be examined.

To the extent that Canada is close to the American market and Canadian technology is influenced by American know how, one would expect a similarity in the production structure of the two countries and therefore a similarity in linkage effects of corresponding industries. To the extent that Canada has a large export sector relative to its national product and to the extent that this sector influences production structure and linkages, Canada's structure is expected to show strong similarities to the production structure of countries that likewise have relatively large export sectors.

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[1]As was indicated in Chapter I, these countries are Japan, Italy, United States and Norway.

The comparisons in this chapter will attempt to show whether or not such expectations materialize. These comparisons are basically comparisons of the input-output tables of the countries involved and refer to value rather than physical terms. This is largely due to the lack of data that are necessary to express the input figures in constant prices. Using the "value" approach, of course, weakens the comparability of input coefficients. If for example, a comparison is to be made of the labor input coefficient, one would like to know the number of man hours that went into the production of one unit (expressed in tons or some other physical quantity) of output of the industry that is to be compared.

If such data are not available, they can be constructed from data giving labor cost (man hour x $\frac{\$\text{ wages}}{\text{man hour}}$) and value per unit of output (e.g. tons x $\frac{\$\text{ price}}{\text{ton}}$) and data on labor wages and per unit prices of the commodity produced.

Since wages and prices are not likely to be the same in different countries a price and wage index is needed to make the input coefficients, whether expressed in physical quantities or in value, comparable. Failure to allow for wage and price differences will result in recording a different coefficient when actually the ratio of physical input to physical output is the same. In the present study, however, the comparisons are not between individual coefficients but between indexes which consider a number of coefficients simultaneously. The linkage effect,

for example, is measured by considering the sum of all inputs purchased by sector j as a fraction of the total value of its production and not a fraction of only one input per unit of output (whether in physical or value terms).

This being the case, it is hoped that not all differences in the prices of inputs in different countries will move in the same direction, so that when the values of all inputs to our industry are summed the upward differences will approximately balance the downward ones and so the linkage effect will not be distorted too much. Furthermore this value approach in the comparisons made here could very well prove to be the lesser of the two evils, the other evil being the construction of very questionable price indexes.

1. Consolidation of Interindustry Data

Before any comparisons of linkages among corresponding industries are made it is essential that industries must be defined (or specified) in a consistent way. That is, if any industry is defined in a certain way in a particular country or period, it must have a similar definition in another country or period if the two industries are to be eligible for comparison.

Such uniform definitions are seldom the case however. Industries that bear the same nomenclature, and are therefore considered the same, are often differently defined in

different countries.

Even within the same country the definition of an industry changes from time to time in order to allow for technological changes, for example, or for simpler or more efficient accounting methods, or sometimes for the sake of improving uniformity with definitions in other countries.

Comparisons under such conditions could be meaningless unless some way is found to make the definitions of industries as uniform as possible. In many cases this can be done by a careful regrouping of the components of an industry. In general, our industry is a collection of individual basic producing units which are grouped together on the basis of some common characteristics. The definitions of such basic units could be the same in different countries or different periods but the definitions of corresponding industries may involve different combinations of such units. In this case, regrouping of basic units although cumbersome is not difficult.

There are cases, however, where basic units are not the same in different countries, but could be more elemental in one country and more inclusive in another. In Japan, for example, the basic unit is measured at the "activity" level while in most other countries the basic unit is the "establishment."[1]

[1] Definitions of terms such as establishment, activity, industry etc. were given in Appendix A of this study.

In such cases aggregation of the smaller units into a bigger one comparable to that in other countries, does not always solve the problem. The reason is that if intra-sector transactions are recorded between activities, then when activities are grouped to form our establishment and establishments are aggregated to form a sector, this sector will be showing a higher consumption of its own products than a sector formed from establishments where there are no records of transactions among their activities. In other words, in the former case there are records of transactions not only between the establishments in our industry but also between the activities in our establishment while in the latter case there is a record of transactions between establishments only. The result of this difference is the appearance of a higher diagonal input coefficient (a_{ii}) in the interindustry matrix of the country using the activity as its basic accounting unit.

In spite of this and some other sources of discrepancy that will be pointed out in the course of the analysis, and because of a lack of a better method, aggregation of smaller into bigger productive units, for purposes of comparability, is the method followed in the present study.

On the basis of this method five aggregated input-output tables were constructed from the published original interindustry tables of the five countries compared.[1]

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[1]See Appendix B, Tables B-1 to B-5.

Four were constructed by Chenery while the fifth, which is the aggregated Canadian table, was constructed as part of this study's work.

The original tables are the following: Japan (1951, size 182 x 182); Italy (1950, size 200 x 56); Norway (1950, size 117 x 117); The United States (1947, size 200 x 200) and Canada (1949, size 42 x 42).[1] The 1949 Canadian table was chosen for this comparison because of the proximity of its date to the dates of the other tables. Choice of the 1961 Canadian table would weaken the comparison because of possible technological changes that might have occurred during the ten years by which this Canadian table differs. The aggregated table 3.1 serves as a basis for the comparison.

Table 3.1 is based on table X of Chenery & Watanabe but it differs from it in two respects.[2] First it has added to it (i.e. to Table X) the standard industrial classifications of the Canadian industries corresponding to those of the other four countries and secondly it shows an additional aggregation of the industries originally included in Chenery's table X. This latter change was necessary in order to form industries that would correspond to their Canadian counterparts. Thus the "shipbuilding" industry (No. 2 in table X)

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[1] H.B. Chenery & Watanabe, _op cit._, p. 489.

[2] H. B. Chenery & T. Watanabe, _op. cit._, p. 507.

TABLE 3.1[1]

INDUSTRY CLASSIFICATION

		International Standard Industrial Classification[a]	Canadian Standard Industrial Classification[b]
1.	Apparel	232, 243	270-279
2.	Leather & Products	291, 292, 241, 242	241-249
3.	Processed Food	201-204, 206-209, 211-214, 220	200-210, 212, 218-225, 227
4.	Fishing	04	091-097
5.	Grain Mill Products	205	213-216
6.	Transportation & Trade	71-73, 611, 612	501-527, 701-709
7.	Industrt n,e,c,	391-396,399	391-399
8.	Transportation Equipment	381-383, 385, 386, 389	330-339
9.	Rubber Products	300	236-239
10.	Textiles	231, 233, 239, 244	251-269
11.	Machinery	360,370	311-324, 326-329 351-359
12.	Iron & Steel	341,350	325
13.	Non-Metallic Mineral Products	33	137, 361-369
14.	Lumber & Wood Products	250,260, 02 (except forestry)	281, 289
15.	Chemicals	311, 312, 319	380-389
16.	Printing & Publishing	28	301-309
17.	Agriculture & Forestry	01, 02 (except logging)	000-089
18.	Non-Metallic Minerals	14, 19	131-133, 139-179
19.	Petroleum & Coal Products	321, 329, 512	373-379
20.	Non-Ferrous Metals	342	341-343, 346, 347, 349
21.	Metal Mining	121, 122	101, 119, 345
22.	Paper & Product	271, 272	292-299
23.	Services	511, 513, 521, 522	602-609
24.	Coal Mining, Petroleum & Natural Gas	11 & 13	121-126
25.	Construction	400	404-439

[1]Table 3.1 is based on H.B. Chenery and T. Watanabe's Table X. H. B. Chenery and T. Watanabe, *op. cit.*, p. 507

[a]United Nations, Statistical Office of the United Nations, *Indexes to the International Standard Industrial Classifications of All Economic Activities* (ST/SRAT/SER.M/R/Rev. 1/Add.1) (New York).

[b]Canada, Dominion Bureau of Statistics, *Standard Industrial Classiification Manual (1951 Census Edition)* (Ottawa: Queen's Printer 1951).

for example, is included in the bigger industry of "transportation equipment" (No. 8 in table 3.1). Similarly the "transport" industry of table X (No. 7 in table X) becomes the "transportation and trade" industry (No. 6 in table 3.1) and so on.

At the level of aggregation of table 3.1 the classification of the five tables is considered fairly consistent. However, before we proceed with comparisons of industries we must keep in mind that in addition to the discrepancies in the specification of industries, other sources of possible errors could affect any conclusions based on such comparisons. Chenery observes, for example, that "Investment is treated differently by Japan and the U.S., on the one hand, and Norway and Italy on the other. In the former, repairs and maintenance are classed as current inputs, whereas in the latter a substantial fraction is charged to final demand as part of gross investment."[1] In the case of Canada repairs and maintenance are treated in the same way as in the U.S. and Japan.[2]

This difference in the treatment of investment causes a difference in the apparent degree of industrial interdependence among the countries compared and would therefore reduce the comparability of the appropriate indexes. Such

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[1]H.B. Chenery and T. Watanabe, op. cit., p. 491.

[2]Dominion Bureau of Statistics, The Interindustry Flow of Goods and Services, (Ottawa, 1956), p. 46.

interdependence for example, will appear to be smaller in the case of Norway and Italy resulting in smaller values for the u_j, w_i, as well as the more comprehensive D_j, S_i indexes in these countries. The reason is that when an activity such as "repair and maintenance" is not considered a current input but part of gross investment it will be charged to both "final demand," when this activity is considered as the product of an industry, and to "value added" when this activity is looked upon as a primary input to an industry. When gross investment is charged to "final demand" total intermediate use W_i will be reduced reducing the w_i and S_i indexes. In the case where gross investment is included in "value added" the total intermediate inputs U_j will be decreased resulting in a decrease in the u_j and D_j indexes.

For the sake of comparability all construction activities, whether for new installations or repairs, are treated as part of final demand in all countries.

One more source of error related to the definition of industries must be kept in mind. It was mentioned earlier that although transactions between activities are not generally recorded, transactions between establishments are. There are exceptions, however, even in this case. Thus Canada does not distinguish transactions among establishments of the same industry.[1] This discrepancy is expected to cause a decrease in the diagonal elements (a_{ii}) in the Canadian interindustry table when this table is aggregated.

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[1] Ibid.

2. Linkage Effects in the Five Countries

In this section the computed values of the relevant indexes of Canadian industries will be compared to those of the corresponding industries in the four other countries.

These comparisons include not only the Chenery type simple u_j, w_i indexes but also the more inclusive D_j, S_i, discussed in Chapter II.

Next, Canadian industries will be classified on the basis of these indexes and the classifications compared to similar ones for the other countries. The purpose of such a classification is to show more clearly the strength of the linkage effects of various industries and thus to outline a group of industries that is more important than others for development purposes.

Let us first look at the u_j, w_i, indexes.

The values of these indexes for Canada are shown in table 3.2 along with corresponding values in the other four countries. The values in the other countries are based on those found by Chenery but modified to take care of additional aggregation of industries mentioned earlier.[1]

In tables 3.3 to 3.7 each sector is classified on the basis of the values of both its u_j as well as its w_i indexes. Thus a two way classification of sectors is used, according to whether the u_j and w_i values of a sector are below or above the mean value of these indexes for all the

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[1]See Table XV of H. B. Chenery & T. Watanabe, _op. cit._ p. 520

TABLE 3.2[1]

RATIOS OF INTERINDUSTRY USE

Industry	Japan	Ratio to Production u_j Italy	U.S.A.	Norway	Canada
1	78.9	66.0	55.5	49.0	49.6
2	82.4	58.4	57.3	61.9	52.7
3	44.3	67.8	71.4	57.6	73.2
4	25.3	23.3	23.5	11.5	20.2
5	94.4	95.2	79.2	97.0	94.2
6	22.4	11.2	24.1	12.2	16.0
7	48.1	46.4	35.9	32.2	28.6
8	64.9	56.3	59.6	42.1	45.8
9	50.6	54.8	48.9	49.3	45.4
10	78.1	73.6	54.1	68.9	43.4
11	63.4	44.8	45.4	46.4	43.1
12	70.4	70.1	57.3	50.6	41.9
13	52.2	48.7	39.4	39.4	39.0
14	68.2	71.6	42.1	51.5	54.2
15	61.2	61.9	57.3	50.4	66.8
16	55.4	53.2	37.7	47.2	40.1
17	17.5	23.9	50.8	22.1	24.9
18	25.7	4.4	21.7	9.2	22.4
19	71.9	46.3	72.9	62.8	62.2
20	50.2	62.8	69.7	70.9	58.6
21	30,9	15.1	18.2	7.6	21.3
22	62.8	53.8	56.6	55.7	56.2
23	27.0	8.4	21.9	31.3	31.9
24	25.7	17.6	7.1	--	10.5
Average	52.9	46.1	46.2	44.6	42.3

[1]Data for Canada are calculated on the basis of the 1949 input-output tables. Data for the four other countries are based on Table XV of H. B. Chenery and T. Watanabe, *op. cit.*, p. 520.

TABLE 3.2[1] (continued)

RATIOS OF INTERINDUSTRY USE

Industry	Japan	Italy	U.S.A.	Norway	Canada
	Ratio to Total Demand w_i				
1	16.5	3.0	16.2	3.8	4.2
2	47.1	31.8	32.1	27.7	27.2
3	16.9	7.1	19.4	5.7	12.0
4	13.7	34.6	48.8	66.2	53.2
5	13.0	48.6	55.6	67.7	60.4
6	21.5	12.1	23.9	13.7	36.5
7	20.3	10.3	29.3	11.9	33.2
8	15.1	4.3	32.5	7.1	34.0
9	56.2	39.7	47.6	15.8	59.4
10	49.5	57.5	63.6	45.6	125.6
11	32.9	22.4	28.0	9.4	22.6
12	74.8	88.2	70.4	38.9	54.1
13	39.7	25.1	35.0	18.6	27.8
14	29.6	43.1	40.4	29.1	18.9
15	70.0	71.1	65.2	46.4	46.1
16	28.8	0	63.6	51.1	56.1
17	73.5	70.1	73.2	60.5	54.2
18	51.8	50.6	52.7	68.1	28.6
19	82.5	70.5	50.7	74.2	147.5
20	66.9	94.0	81.5	48.7	40.7
21	98.0	85.4	95.9	59.2	14.2
22	80.2	75.3	79.2	42.5	35.8
23	35.6	45.0	32.2	33.2	60.8
24	96.9	100.3	83.3	--	72.4
Average	46.8	41.7	50.8	36.7	36.9

[1]Data for Canada are calculated on the basis of the 1949 input-output tables. Data for the four other countries are based on Table XV of H. B. Chenery and T. Watanabe *op. cit.* p. 520.

sectors in the country.[1]

In the Chenery study the u_j, w_i values of corresponding industries have been averaged out for the countries involved and the industries were then summarily classified on the basis of the mean values of these indexes in table III.[2] Since we are interested, however, to discover any similarities or differences between Canadian industries and industries in each of the other countries, this summary classification is least helpful. Instead a separate table was constructed for each country and the Canadian table will be compared to each.

In all five tables the term "Final" refers to sectors with low values of w_i, that is to sectors whose products go mostly to final demand and very little to other industries for further processing. The terms "Primary" on the other hand, signifies a sector with a low u_j index; that is a sector which makes use mostly of primary inputs and very little of intermediate inputs obtained from other industries. Sectors with a high u_j value are sectors engaged in further processing of intermediate inputs and are therefore termed "manufacturing" sectors. Such sectors could be catering mostly to final demand in which case they can be identified as "Final Manufacture" (category III in tables 3.3 to 3.7), or they can sell their products to other sectors for further

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[1] The u_j, w_i averages for each country appear at the bottom of Table 3.2.

[2] See Table III of H. B. Chenery & T. Watanabe, op. cit., p. 493.

processing in which case they are termed "Intermediate Manufacture" (category II). Sectors with low u_j could also be divided into these who sell exclusively to final demand and could therefore be considered as belonging to the category of "Final Primary Production" (category IV) and into those who sell their outputs as inputs to other sectors and could be included in the "Intermediate Primary Production" category (category I).

Of these four categories, category III includes industries with relatively strong "backward" linkage effects, while category I includes industries with relatively strong "forward" linkage effects. Category IV (Final Primary Production) includes the kind of industries that not only depend very little on other producers, but they also sell their product to final demand. They are therefore the kind of industries least likely to attract other industries (they provide neither a market nor a source of supply to other industries) and therefore to cause any development in the area where they are located. The direct opposite of this category is category II (Intermediate Manufacture). This category includes sectors that have strong backward as well as forward linkage effects. These are the sectors that are most likely to draw other industries in the areas where they are located, or can be expected to increase production in these industries with which they are linked if an increase in demand for their products (the products of industries in category II) occurs.

TABLE 3.3

TYPES OF INDUSTRIES IN JAPAN

	Final $w_i < 47$				Intermediate $w_i > 47$			
$u_j > 53$ Manufacturing	III Final Manufacture		u_j	w_i	II Intermediate Manufacture		u_j	w_i
	1.	Apparel	79	17	9.	Rubber Products	51	56
	2.	Leather & Products	82	47	10.	Textiles	78	50
	5.	Grain Mill Products	94	13	12.	Iron & Steel	71	75
	8.	Transport Equipment	65	15	15.	Chemicals	61	70
	11.	Machinery	63	33	19.	Petroleum & Coal Products	72	83
	13.	Non-Metallic Mineral Products	53	40	20.	Non-Ferrous Metals	50	67
	14.	Lumber & Wood Products	68	30	22.	Paper & Products	63	80
	16.	Printing & Publishing	55	29				
$u_j < 53$ Primary Production	IV Final Primary Production		u_j	w_i	I Intermediate Primary Production		u_j	w_i
	3.	Processed Food	44	17	17.	Agriculture & Forestry	18	74
	4.	Fishing	25	14	18.	Non-Metallic Minerals	26	52
	6.	Transport & Trade	22	22	21.	Metal Mining	31	98
	7.	Industry n.e.c.	48	20	24.	Coal Mining Petro-eum and Natural Gas	26	97
	23.	Services	27	36				

Note: Table based on data taken from Table 3.2.

TABLE 3.4

TYPES OF INDUSTRIES IN ITALY

	Final $w_i < 42$				Intermediate $w_i > 42$			
	III	Final Manufacture	u_j	w_i	II	Intermediate Manufacture	u_j	w_i
Manufacturing $U_j > 46$	1.	Apparel	66	3	5.	Grain Mill Products	95	49
	2.	Leather & Products	58	32	10.	Textiles	74	58
	3.	Processed Food	68	7	12.	Iron & Steel	70	88
	8.	Transport Equipment	56	4	14.	Lumber & Wood Products	72	43
	9.	Rubber Products	55	40	15.	Chemicals	62	71
	11.	Machinery	46	23	19.	Petroleum and Coal Products	46	71
	13.	Non-Metallic Mineral Products	49	25	20.	Non-Ferrous Metals	63	94
	16.	Printing & Publishing	53	0	22.	Paper & Products	54	75
	IV.	Final Primary Production	u_j	w_i	I	Intermediate Primary Products	u_j	w_i
Primary Production $U_j < 46$	4.	Fishing	23	35	17.	Agriculture & Forestry	24	70
	6.	Transport & Trade	11	12	18.	Non-Metallic Minerals	5	51
	7.	Industry n.e.c.	46	10	21.	Metal Mining	15	85
					23.	Services	9	45
					24.	Coal Mining Petroleum & Natural Gas	18	100

Note: Table based on data taken from Table 3.2.

TABLE 3.5

TYPES OF INDUSTRIES IN U.S.A.

	Final $w_i < 51$			Intermediate $w_i > 51$		
	III Final Manufacture	u_j	w_i	II Intermediate Manufacture	u_j	w_i
Manufacturing $u_j > 46$	1. Apparel	56	16	5. Grain Mill Products	79	56
	2. Leather & Products	57	32	10. Textiles	54	64
	3. Processed Food	71	19	12. Iron & Steel	57	70
	8. Transport Equipment	60	33	15. Chemicals	57	65
	9. Rubber Products	49	48	17. Agriculture & Forestry	51	73
	11. Machinery	46	28	19. Petroleum & Coal Products	73	51
				20. Non-Ferrous Metals	70	82
				22. Paper & Products	57	79
	IV Final Primary Production	u_j	w_i	Intermediate Primary Production	u_j	w_i
Primary Production $u_j < 46$	4. Fishing	24	49	16. Printing & Publishing	38	64
	6. Transport & Trade	24	24	18. Non-Metallic Minerals	22	53
	7. Industry n.e.c.	36	29	21. Metal Mining	18	96
	13. Non-Metallic Mineral Products	39	35	24. Coal Mining, Petroleum and Natural Gas	7	83
	14. Lumber & Wood Products	42	40			
	23. Services	22	32			

Note: Table based on data from Table 3.2

TABLE 3.6

TYPES OF INDUSTRIES IN NORWAY

	Final $w_i < 37$			Intermediate $w_i > 37$		
Manufacturing $U_j > 45$	III Final Manufacture	u_j	w_i	II Intermediate Manufacture	u_j	w_i
	1. Apparel	49	4	5. Grain Mill Products	97	68
	2. Leather & Products	62	28	10. Textiles	69	46
	3. Processed Food	58	6	12. Iron & Steel	51	39
	8. Transport Equipment	43	7	15. Chemicals	50	46
	9. Rubber Products	49	16	16. Printing & Publishing	47	51
	11. Machinery	47	10	19. Petroleum & Coal Products	63	74
	14. Lumber & Wood Products	52	29	20. Non-Ferrous Metals	71	49
				22. Paper & Products	56	43
Primary Products $U_j < 45$	IV Final Primary	u_j	w_i	I Intermediate Primary Production	u_j	w_i
	6. Transport & Trade	12	14	4. Fishing	12	66
	7. Industry n.e.c.	32	12	17. Agriculture & Forestry	22	61
	13. Non-Metallic Mineral Products	39	19	18. Non-Metallic Minerals	9	68
	23. Services	32	33	21. Metal Mining	8	59

NOTE: Table based on data from Table 3.2.

TABLE 3.7

TYPES OF INDUSTRIES IN CANADA

	Final $w_i < 36$			Intermediate $w_i > 36$		
Manufacturing $u_j > 42$	III Final Manufacture	u_j	w_i	II Intermediate Manufacture	u_j	w_i
	1. Apparel	50	4	5. Grain Mill Products	94	00
	2. Leather & Products	53	27	9. Rubber Products	46	59
	3. Processed Food	73	12	10. Textiles	44	125
	8. Transport Equipment	46	34	12. Iron & Steel	43	54
	11. Machinery	43	23	15. Chemicals	69	46
	14. Lumber & Wood Products	54	19	19. Petroleum & Coal Products	62	147
				20. Non-Ferrous Metals	59	41
				22. Paper & Products	56	36
Primary Production $u_j < 42$	IV Final Primary Products	u_j	w_i	I Intermediate Primary Products	u_j	w_i
	7. Industry n.e.c.	29	33	4. Fishing	20	53
	13. Non-Metallic Mineral Products	39	28	6. Transport & Trade	10	37
	18. Non-Metallic Minerals	23	29	16. Printing and Publishing	40	56
	21. Metal Mining	21	14	17. Agriculture & Forestry	25	54
				23. Services	32	61
				24. Coal Mining, Petroleum & Natural Gas	11	72

NOTE: Table based on data taken from Table 3.2.

One way of comparing the similarities or differences that exist between the Canadian structure of production and that of each of the other countries, is to see which pair of countries has the least shifting of sectors among the four categories. In other words, countries will be considered more similar if they are found to have the same sectors in each category. Since the u_j, w_i indexes reflect a country's industrial structure and since industries have been classified in each category on the basis of these two indexes, it follows that the more similar is the productive structure of a pair of countries the greater will be the number of "same" industries falling in each category. The term "same" shall be taken to mean industries similarly defined.

To keep things comparable, the number of the "same" industries falling in each category will be expressed as a percentage of the average number of all sectors falling in the same category in each pair of countries. Thus if a country has a total number of industries falling in category I equal to 6 e.g., while the second country in the pair, has a total number of sectors falling in this same category equal to 4, the average number of sectors for the two countries falling in category I will be equal to 5. If only 3 sectors are the same in both countries then the percentage of the "same" sectors falling in this category is $\frac{3}{5} \times 100$ or 60%.

Table 3.8 shows such percentages for each pair of countries that include Canada.

TABLE 3.8

PERCENTAGE OF INDUSTRIES PRESENT IN THE SAME CATEGORY IN EACH PAIR OF COUNTRIES

Countries Categories	Canada Japan	Canada Italy	Canada U.S.A.	Canada Norway
I	40%	54%	40%	40%
II	92	87	87	87
III	71	71	83	92
IV	22	29	40	50

Note: Percentages are calculated on the basis of data from Tables 3.3 to 3.7. Categories I to IV correspond to those of Tables 3.3 to 3.7 also.

A comparison of the five countries based on the relative size of these percentages shows that there is no reason to believe that any pair of countries is more similar than any other pair. There is no pair of countries that has consistently higher percentage values than any other. The comparison, however, brings out an important fact. If one look at the size of the percentages in each pair we observe that the percentage of sectors that are the same is much greater in categories II and III than in I and IY. In other words groups II and III are much more stable (include the same industries) when different countries are considered than are the other two groups.

The reasons for such a constancy of categories II & III will become clearer as we proceed to analyze each group more closely. The importance, however, of this observation is clear. Since groups II and III contains the type of industries that have the relatively stronger "backward" linkage effects and are therefore the more desirable type of industries for the development of an area, the similarity of these industries with regards to linkage effects is reassuring. If an industry was to be chosen, e.g., for the explicit purpose of bringing a new impetus of economic activity in an area, it would be nice to know that the strong linkage characteristics exhibited by that industry in country or area A are going to be present when this industry is established in area B.

If we now look at the individual sectors in each group, we note that sector 5 (grain mill products) is classified in category II for all countries except Japan.[1]

In the case of Japan a relatively higher percentage (i.e., relative to the percentage in the other countries) of the products of this sector is absorbed by domestic final demand (87%).[2] This results in a low w_i value for this sector in Japan.

It is possible that in Japan several products of sector 5 are consumed after the milling process is completed, while in the other countries, including Canada, such products are further processed by other subsectors within sector 5 to become corn, wheat, or rice flakes e.g. This could explain in part the higher intraindustry coefficient (a_{ii}) for sector 5 in the other countries while this intra-industry coefficient is comparatively small in Japan.[3] This difference in habits between Japan on the one hand, and the other four countries on the other, influences the strength of the linkage effects of the industry. In this case it lowers the "forward" effect of sector 5 in Japan.

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[1]The numbering of sectors and categories refers to that of Tables 3.3 to 3.7 of this study.

[2]This percentage is calculated on the basis of Table XI of H. B. Chenery and T. Watanabe, op. cit., pp. 216-17.

[3]See Tables B.1 to B. 5 in Appendix B of this study.

A second industry that falls within this category is that of "Textiles" (sector 10). This occurs in all countries with no exceptions. It is worth noting that the values of both its "backward" (u_j) as well as its "forward" (w_i) indexes are distinctly above the average values for these indexes in any of the countries examined.

A third industry that is classified in this group without exceptions as among the countries examined is the "iron and steel" industry (No. 12). This is no surprise to those who are aware of the importance of iron and steel products for industries such as the "construction," "capital equipment" and "transport equipment" industries to mention only a few of the possible user industries.

The "chemical industry" (No. 15) is a fourth industry belonging to the "Intermediate Manufacture" category in all five countries. This again is to be expected with chemical products used everywhere today as inputs to other industries and the industry using inputs from the "petroleum and coal products" to "agriculture and forestry" industries.

A fifth industry that falls in category II for all five countries is the "petroleum and coal products" (No. 19) industry showing a very high "forward" link in Canada. Since this industry's definition includes not only oil and coal products but also gas manufacturing and the distribution of manufactured as well as natural gas, it is to be expected that such industry should show a high w_i value for Canada. Canadians winter conditions that make for a great use of

natural gas as a fuel and modern technology that permits the use of natural gas as a raw material for the chemical and particularly the petrochemical industries provide a large domestic market for natural gas. The great distances between end points within Canada on the one hand, which make for a substantial use of oil and oil products by commercial transportion media and the use of oil as a source of energy by a great number of industrial establishments on the other, provide a large domestic intermediate market for the second product of this industry.

If we now add the fairly extensive use of coal products by the steel, the chemicals and the utilities industries in Canada, we could easily see why the "forward" (w_i) value of this industry is as high as that observed here.

Technology and the greater use of it makes for the difference in classification of the "agriculture and forestry" (No. 17) industry among the five countries. Of these countries only the United States has the industry included in the "Intermediate Manufacture" category. A look at the interindustry tables of the five countries indicates the degree to which this industry uses inputs coming from other industries. Although the U.S. table does not show much greater use of any particular intermediate product by the industry with the exception of inputs from the "chemicals" and the "services" industries, it does show that the "agriculture and forestry" industry does draw inputs from almost every industry in the U.S. table while this is not

the case in the other countries. There is definitely a greater use of chemicals, whether as fertilizers or pesticides, and a greater use of services, in the U.S. than in the other countries. There is also a greater use of products coming from the "grain mill products" industry, (animal feeds e.g.), the "machinery," the "rubber products," the "iron and steel" and other industries. "Non-ferrous metals" (No. 20) is yet another industry falling in this category in all five tables. Canada shows a somewhat lower w_i index for this industry as compared to other countries but the value of this index is still well above the average w_i for all Canadian industries ($w_i = 41$ for "non-ferrous metals," while the average w_i for Canada is $w_i = 36$).

The Canadian "paper & products" sector (No. 22), is also classified in the "Intermediate Manufacture" category although the closeness of its w_i value to the Canadian average make this classification to be a borderline case.

The reason for this sector's low w_i value is that a high proportion (59%)[1] of its output is exported. Since exports are included with final demand, it means that inter-industry demand W_i must be low and in turn the value of the $w_i = \frac{W_i}{Z_i}$ ratio must also be low.

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[1]The percentages are calculated on the basis of the aggregated 1949 Canadian input-output tables.

The last Canadian Sector included in this category is that of "rubber products" (No. 9) which is not in this category for any other country except Japan. The two main users of the products of this industry in Canada are those of "transportation equipment" and"machinery." Japan seems to be using rubber products in some industries that are not big users in other countries such as "fishing," "transportation and trade" and "metal mining."

The similarity shown by category II (Intermediate Manufacture) for the five countries, strongly suggests that, at least for the sample of countries examined here, the great majority of the industries included in it possess the relatively strong combined linkage effects regardless of where they are located.

The group of industries that can be considered to be almost as important as group II is that of "Final Manufacture" (Category III in tables 3.3 to 3.7). The reason is that it contains industries having relatively strong "backward" linkage values.

If we accept the fact that the "backward" linkage effect is a stronger attractive force than the "forward" then we must think of the industries in this group as being the type of industries, that along with those of group II, must be considered when an expansion in industrialization is desired. Their difference from those of category II is that they sell mostly to final demand.

A comparison of the five tables shows that with the exception of the "lumber & wood products" (No. 14) and "non-metalic mineral products" (No. 13), which are borderline cases, the group contains the same type of industries. The group in other words displays the same stability as that shown by category II.

The group that shows the greatest variations among the five countries is group IV (final primary production). As the name of this group implies, the industries in it are not only primary-type industries using very little intermediate inputs but they also sell almost exclusively to final demand. Any differences therefore in factor endowments (primary inputs) among countries could result in the presence or absence of an industry from this group. Similarly differences in the composition of final demand could make this group very different from country to country. Where, for example, final demand is strong for the products of primary industries, the industries will appear in group IV, otherwise they will show up in other groups.

Differences in the composition of final demand could originate in the domestic as well as the foreign component of final demand. Differences in the domestic component could in turn come from differences in taste (products of the fishing industry may be more popular in Japan than they

are in Canada) or income levels (services e.g. could be expected to sell a greater proportion of their output to final demand where income levels are higher). Differences in the foreign component of final demand could be the result of one or both of the following reasons. On the one hand, the existence of good foreign markets for primary products creates an incentive to expand mining operations; on the other hand, however, the very existence of such good foreign markets weakens the desire to establish user industries that would take advantage of available sources of raw materials. The "non-metallic minerals" sector (No. 18) seem to be such a case in Canada.

The direct connection between the industries in this group and final demand is the reason why these industries have the weak "forward" linkages observed. This does not mean however, that their linkage effects cannot be improved, at least for the industries whose output is mainly exported. A reduction in exports in this case, for example through an export tax, could help develop their latent "forward" effects. But unless something is done to enhance the "forward" linkage strength for local development, the development will occur abroad where user industries are established.

Group I (Intermediate Primary Products) also shows variations among the five countries although not as many as in category IV. There are here several reversals mostly between this category and category IV with most of the reversals occurring in the case of Canada.

The first reversal we notice is that of the "metal mining" industry (Ind. No. 21), which in the case of Canada is classified with group IV, instead of group I as in the other countries. The reason for the low w_i value of this industry in Canada is that a high proportion of its output (84%) is shown to be exported according to the 1949 Canadian interindustry table. In the United States, on the contrary, over 51% of the American industry's output was absorbed by the U.S. "iron and steel" industry as against only 2.5% in the case of Canada.[1] No wonder the U.S. "metal mining" industry is showing a "forward" w_i value of about 96 while the same industry in Canada shows only a value of 14.[2] In fact the w_i index for this industry in all other countries examined is much higher than that of Canada.

Why such a difference between Canada and these other countries? It is difficult to have a conclusive answer without examining all pertinent factors and one could only suggest some possible reasons.

For example, the high linkage between the metal mining and the user industries in the other four countries is very probably the result of a combination of "backward" as well as "forward" linkage effects. That is, the "backward" effect of user industries, such as steel, established

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[1]See Tables B.1 and B.5 of Appendix B of this study.

[2]See Table 3.2 of this study.

there to satisfy perhaps a high demand for their products, caused explorations and mining operations to begin. On the other hand, the resource oriented nature of the user industries forced them to locate close to the sources of raw materials. In other words the "forward" linkage effect of the metal mining industries was permitted to operate fully.

In Canada, however, both these effects were weak. In the first place the market was not exerting much pressure for the establishment of metal working industries. Most of the steel products were imported from Britain. It took a severe shortage due to various delays of railroad stock needed, for example, to cause the establishment of the first large scale steel production in Hamilton.[1] In the second place accessibility to foreign markets and improvement in transportation permitted the products of mining industries to slip out of the country and thus the forward linkage effect of the mining industries was not allowed to operate in Canada.

It may be argued that exports of mining products were very necessary at the earlier stages of the country's development in order to provide the foreign exchange that would buy the variety of manufactured investment as well as consumer goods that were needed then. This may be so, but the development of the foreign market and the routine established between Canadian producer and foreign buyer of

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[1]The Sudbury Star (Sudbury, Ontario), January 13, 1972, p. 22.

mining products are factors that build up a resistence for any change in the status quo. Domestic producers e.g. may not want to be dependent on one or a limited number of domestic user industries who could then regulate prices by virtue of their oligopsonistic power and by possibly lobbying for export taxes on the mining products they buy. Foreign customers on the other hand, may use every possible means in their power to see that they are not cut off from a reliable source of supply. It takes a fairly violent shock, as for example, a severe shrinkage of foreign markets, before serious thoughts would be given to establishing domestic user industries.

It took the recent slump in the nickel markets abroad to start a serious searching for new uses for nickel and a serious thinking of establishing more nickel using industries in Canada.[1]

The conclusion that may be drawn from the above discussion is that although mining industries are an absolute necessity to user industries and are therefore expected to have very strong "forward" linkage effects, the observed value of such effects may be very small because the linkages are between the mining industry and the foreign user established abroad and cannot therefore be reflected in the

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[1] The Sudbury Star (Sudbury, Ontario), December 23, 1972, p. 1.

w_i index. But the point here is not whether the observed w_i is high or low, the point is rather that although the true w_i (the one that shows the extent of the link between a producing and a using industry, even if the using industry is located abroad) could be very high, it is not a strong enough force, for the reasons given above, to attract the user industries where the producer is located.

If any predictions can be made for industrial development in Canada emanating from metal mining activities, these predictions will have to be pessimistic. With good foreign markets for the products of this Canadian industry, the pressure for establishing industries in Canada that will make substantial use of metal mining products will be minimal.

Another reversal in the classification of sectors occurs in the case of sector 18 (non-metallic minerals). This sector shows a w_i index which is lower for Canada than for any other of the four countries.[1]

Here again, as in the case of "metal mining" industry, the reason is one of high export proportion for the output of that industry.

When one looks at the 1949 input-output for Canada,[2] he will notice that one of the major Canadians user of this industry's product is sector 13 (non-metallic mineral products)

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[1]See Table 3.2 of this study.

[2]See Table B.1 of Appendix B of this study.

But sector 13 processes only such minerals as clay, stones, gypsum, asbestos etc. It does not process chemical raw materials such as potash, sulphate salts etc., which are included in the "non-metallic minerals" sector and which are usually processed by chemical industries. The chemical industry in Canada, however, at least up to 1949 draws very little from the "non-metallic minerals" sector as can be seen from an examination of the 1949 table. It must therefore be that the main body of the exported product of that industry consists mainly of chemical raw materials used as inputs in chemical industries abroad. Here again it is rather unlikely that the "non-metallic minerals" industry will attract user industries in Canada at least not as long as markets abroad continue to be strong for chemical raw materials.

One of the few Canadian natural resource industries that show a fairly high forward linkage is that of "coal mining, petroleum and natural gas" (sector No. 24). Although its w_i index is somewhat lower than that of the corresponding industries in the other countries, it is well above the average w_i index for all Canadian industries ($w_i = 72$ for sector 24 while the Canadian w_i average is $w_i = 36$. A high proportion of this industry's output (higher than 38%) goes to the Canadian sector of "petroleum and coal products."

Here, unlike the natural resource industries examined so far it appears that the existence of coal, petroleum and natural gas in Canada has attracted the user industries of "petroleum and coal products." A closer

look,however, at the factors that might have caused the establishment of the "petroleum and coal products" industry close to the source of supply weakens this conclusion.

Firstly there is an ample market in Canada for the "petroleum and coal products" industry whose output can always be used for heating and fueling purposes. The existence of a market,therefore, could be considered a bigger incentive for the establishment of the "petroleum and coal products" industry than the existence of sources of supply. If coal was needed it could have been imported if coal mines did not exist in Canada. Similarly oil could have been imported. Natural gas would be more difficult to import unless the United States would be willing to sell. Gas,however, could be manufactured from coal and so even this difficulty could have been overcome. The conclusion thus is that,even in the case of industry 24, the establishment of using sectors would not be certain had it not been for the existence of a strong market for the products of these sectors.

A third reversal occurs in industry 4 (fishing). This sector in Canada shows a relatively high value for w_i (w_i = 53) and is therefore classified with "Intermediate Primary Production" (category I). Over 54% of this industry's output is absorbed by the "processed foods" industry (No. 3), while the percentage exported as unprocessed product is low. Only Norway has a w_i index for this industry which is higher than that of Canada

(w_i = 66 for the fishing industry for Norway).

The conclusions that can be drawn from the comparison of the u_j, w_i indexes among the five countries could be summarized as follows.

When industries are classified according to the method followed in tables 3.3 to 3.7 it can be seen that there is a difference in the similarity of the four categories in these tables. Categories II and III, that is that of "Intermediate" and that of "Final" Manufacture respectively, show the greatest stability and contain very much the same sectors regardless of the country examined. Categories IV (Final Primary Production) and I (Intermediate Primary Production) on the other hand, are more unstable and the industries contained in them shift between the two categories as different countries are examined.

Categories II and III are those that include industries with above average "backward" linkage strength while industries in categories I and IV are those whose "backward" strength is relatively weak.

This observation suggests that there is a correlation between the strength of the "backward" linkage (u_j index) of industries and the constancy of the categories containing such industries. In other words the stronger is the "backward" linkage effect of an industry, the greater the probability that this industry will fall in the same category regardless of country. Those industries that show relatively weak "backward" linkages shift from category I to category IV

and vice versa regardless of the strength of their "forward" linkage effect.

This behavior among industries is an additional indication of the superiority of the "backward" over the "forward" effect in inducing other industries to locate close to the already established ones.

If the linkage effect of an industry "backward" or "forward" is the main factor of attracting other industries in a country or region where the first industry is located, then this linkage effect as measured from the input-output table of that country or region will not only be high there, but it will also be high in any country or region where such an industry exists. This is so since the linked industries, if truly attracted by the linkage effect of the original industry, will always be there to cause the appearnce of a high value for the linkage effect of that industry. If on the other hand the linkage effect of an industry is not the main factor for attracting other industries, there is no guarantee that the linked industries (suppliers or users) will always be in the region where the first industry is. If they are, they may be for other reasons. When they are not, their absence will cause the observed value of the linkage effect to be low. When they are present the measured value of the linkage effect will be high. But since the linkage effect of the first industry is not the cause of their presence or absence, its value will have a stochastic character being high in countries where reasons

other than linkage effects have attracted the industries linked with the original one, and low in countries where such other reasons are not present. In other words where a linkage effect is capable, on its own, to attract other industries, the attracted industries will be in a region whenever the industry having that effect is in that region and their presence will cause a high observed value of that effect. Where a linkage effect of an industry is not so capable, its observed value will fluctuate because the industries linked to the first one may or may not be in the region depending on factors stronger than the linkage effect. Their presence or absence will thus cause the value of that effect to be high or low.

Since a constancy in the classification of industries in tables 3.3 to 3.7 is observed only where "backward" linkages are strong regardless of the strength of the "forward" linkage effects, it follows that it is the "backward" linkage effect that has the stronger attractive pull.

One of the main reasons for the constancy of classification of the industries having relatively strong "backward" linkages is perhaps the positions that such industries occupy within the industrial framework. The fact that they show high "backward" values indicates that they are very dependent not so much on raw materials but on intermediate or semi-manufactured materials. But these intermediate materials exist because the going technology both requires them and can produce them. In other words the type of intermediate

inputs in the market reflect the state of the technology that a country possesses. Since industries with strong "backward" effects make a relatively greater use (relatively to other industries) of such inputs it means that they themselves, are relatively more affected by the existing technology. Technology today is not likely to be much different among countries and thus industries with strong "backward" linkage are likely to buy from the same supplier and probably from the same number of suppliers regardless of the country in which they are located. Hence the greater degree of comparability observed among such industries.

Another reason that may affect the apparent stability of the manufacturing sectors (i.e. sectors of categories II and III) is most likely the greater statistical accuracy of recording activities within these sectors than within industries belonging to the "Primary Production" categories whether "Final" or "Intermediate" (categories I and IV respectively, of tables 3.3 to 3.7). This relatively greater accuracy may result in a finer delineation of the boundaries of an industry belonging to categories II and III. This in turn may result in a greater comparability of such an industry than an industry belonging to categories I and IV. Industries such as "services" e.g., (No. 23) or "Industry n.e.c." (No. 7) may have fairly different specifications in different countries, because of such statistical deficiencies, and could therefore appear in different categories in each of these countries.

A second observation that can be made from the international comparison of the u_j, w_i indexes, is that although in general Canada's productive structure, as reflected in these two indexes, strongly resembles that of the four other countries, this similarity does not appear to be stronger or weaker for any particular comparison. In other words, the results of the comparison do not show that there exists a greater similarity between Canada and the U.S. for example, than there is between Canada and any of the remaining countries. This could be the result of a fairly similar technology among the countries examined and the relatively stronger influence that technology has on the structure of production as compared to influences arising from possible similarities in final demand or resource endowments among these countries.

On the basis of comparisons and analyses made so far, a list could be compiled containing industries most likely to generate further industrialization in the area or country in which they are located.

In accordance with the conclusions arrived at, the main characteristic of such industries should be their relatively strong "backward" linkage effect as measured by the u_j index. To minimize the chances of including a doubtful case, the list will include only those industries that are in categories II and III for all countries without

exception.[1] That is, if an industry is included in these two categories in some but not all countries, it will be excluded from the list.

Following is such a list of industries.

TABLE 3.9

INDUSTRIES MOST LIKELY TO GENERATE FURTHER INDUSTRIALIZATION.[2]

1.	Apparel	11.	Machinery
2.	Leather & Products	12.	Iron & Steel
5.	Grain Mill Products	15.	Chemicals
8.	Transport Equipment	19.	Petroleum & Coal Products
9.	Rubber Products	20.	Non-Ferrous Metals
10.	Textiles	22.	Paper Products

It has been argued by Hirschman that in cases where the industrial network of a country is not developed enough to allow for extensive markets for intermediate goods, industrialization could begin "with industries that deliver to final demand."[3] If these industries were of the type

[1] Categories II and III in Tables 3.3 to 3.7 are those containing industries with relatively strong u_j values.

[2] This list is based on the classification of industries made in Tables 3.3 to 3.7 of this study.

[3] A. O. Hirschman, op. cit., p. 111.

that purchase their inputs from other sectors rather than from primary resources directly, they could cause the establishment of the supplier industries within their region because of the market these buyer industries create. If the supplier industries are also of the type that use intermediate inputs, they could in turn attract their own supplier industries and the process would continue down to the sectors that use mostly primary resources.

This process suggests a pattern of interdependence or hierarchy among industries which has at the top an industry whose output goes entirely or mostly to final demand and which buys intermediate inputs from other industries. Next to this top industry there is a small number of other industries that sell to the top industry and buy inputs from other industries except the top one and so on. This pattern ends in a number of industries that sell their outputs to all industries and possibly to final demand but which do not buy inputs from other industries. One could imagine therefore, a sort of a pyramid or triangle having at the top industries selling exclusively to final demand and buying from other sectors and at the bottom industries that use only primary factors and sell to all other industries.

Knowledge of such a pattern in a country, if it exists, could be used to select industries that could start the process in areas of that country that need to expand their industrial base.

The question as to whether or not such an industrial

hierarchy exists in a country can be answered by examining the input-output matrix of that country. Having answered this question for Canada we would then like to see whether or not the revealed pattern is similar to the patterns found in some or all of the other four countires. That is we would like to see whether or not technological or other factors are sufficiently strong to produce similar patterns of interdependence among countries.

In order to discover whether such a pattern exist the input-output table of a country should be triangularized. This means that the industries in the table should if possible be rearranged in such a way that there is a sequence of sectors leading from primary to finished products. The more an economy comes close to such a one-way pattern of interdependence, the more triangular the table will look.

There are several methods for triangularizing an input-output table. H. Aujac[1] suggests a criterion of "better customer" according to which sector A is considered a better customer than sector B if the delivery from A to B in relation to the total output of A is smaller than the delivery from B to A in relation to the total output of B. Thus sectors that are better customers than a given sector are arranged so that they are to the right or below the given sector in the matrix. As Aujac himself points out,

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[1]H. Aujac, "La hierarchie des industries dans un tableau des echanges interindustriels et ses consequences sur la mise en oeuvre d'un plan national decentralise," en <u>Revue economique</u> Vol. XI, No. 2, 1960, pp. 169-238.

however, this criterion is not sufficient to triangulate actual interindustrial matrices. Another criterion has been suggested by Simpson and Tsukui.[1] According to this criterion, sectors are arranged so as to maximize the sum of transactions under the principal diagonal of the matrix. Similar to this method is the procedure used by Chenery and Watanabe[2] which is also followed in this study for reasons of uniformity since Canada is compared to the countries examined by the two authors.

The method consists of minimizing the sum of transactions falling above the diagonal and thus making the interindustry matrix as close to triangular as possible. Sectors are first arranged in order of increasing w_i or of decreasing u_j and the resulting above diagonal totals are computed. A trial and error procedure follows consisting of moving a sector upward in the ranking. If the reduction of its U_{j}. component (its total purchases from other sectors) is greater than the increase in its W_i component (its total sales to other sectors) the result is considered an improvement and the sector is left in this higher position, otherwise it is brought back to its previous position and another sector is tried. The improvement results from the fact that

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[1] D. Simpson and J. Tsukui, "The Fundamental Structure of Input-Output Tables: An International Comparison," in <u>Review of Economies and Statistics</u>, Vol. 47, 1965, pp. 434-446.

[2] H. B. Chenery and T. Watanabe, <u>op</u>. <u>cit</u>., footnote p. 496.

when U_j is reduced by more than the W_i is increased, the above diagonal total of the two (i.e. $U_j + W_i$) is reduced thus reducing the sum of all transactions above diagonal and making the matrix close to triangular.

The results of this experiment for each of the five countries are shown in Table 3.10. The meanings of the abbreviations used in this table are: J = Japan, I = Italy, U = United States, N = Norway and C = Canada. Table 3.10 is similar to table IV of Chenery and Watanabe.[1] However because of the additional aggregation of sectors that was necessary in the present study and the addition of Canada in the list of countries, both the country as well as the average ranking of sectors are different than that in Chenery's table. Chenery calls this "average" ranking of sectors "compromise" ranking. Whatever the name, the meaning is the same. It denotes a ranking of sectors based on the averages of the rankings of each sector in the various countries. Thus the "Transport Equipment" sector which is ranked 4th in Japan, 1st in Italy, 2nd in the U.S., 1st in Norway and 4th in Canada, has an average ranking of 2.4[2]. This value is smaller than the value found for the next sector of "apparel," which is 3.2. The "Transport Equipment" sector therefore is placed above the "apparel" sector on the basis of its smaller

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[1] Ibid., 495.

2These rankings refer to Table 3.10 of this study.

TABLE 3.10

ORDERING OF INDUSTRIES IN TRIANGULAR ARRANGEMENT

Industry (Compromise Ranking)	Country Ranking					t_i, t_j % Transactions Above Diagonal									
						J		I		U		N		C	
	J	I	U	N	C	Row	Col.	Row	Col.	Row	Col.	Row	Col.	Row	Col.
1. Transport Equipment (8)	4	1	2	1	4	12.9	0	0	0	11.8	0	.3	0	68.5	1
2. Apparel (1)	1	10	1	2	2	6.7	0	.4	0	.3	0	2	0	27.8	.1
3. Leather (2)	5	4	4	3	1	1.2	3.7	.5	0	2.3	.2	.5	0	13.2	.2
4. Processed Food (3)	3	3	6	4	3	9.7	0	2.4	0	4	0	1.4	0	0	0
5. Fishing (4)	6	2	3	5	8	10.2	3.2	.4	16.2	10.4	0	.3	1.4	0	2.4
6. Industry n.e.c. (7)	11	6	8	6	5	12.4	.4	2.6	.7	16.8	2.1	13	0	64.5	4
7. Grain Mill Product (5)	2	11	5	17	6	4.6	2	9.6	0	43.3	4.6	41.1	.3	73.2	4
8. Transport & Trade (6)	10	5	7	8	19	3.9	7.6	1.6	1.5	4.1	7.6	2.9	.4	7.1	41
9. Rubber Products (9)	7	7	9	7	20	39.2	0	2.7	1.2	17	0	5.9	1.0	0	29
10. Machinery (11)	9	9	14	13	7	10.5	1.1	.6	0	5	.3	2.8	.9	50.4	3
11. Non-Metallic Mineral Products (13)	13	14	13	9	10	8.2	3.4	4.8	.6	6.8	2.2	10.1	0	33.2	9
12. Textiles (10)	8	8	11	12	21	2.6	.4	1.2	.1	3.5	1.4	3	1	0	29
13. Lumber & Wood Products (14)	15	13	10	11	12	10.1	.8	4.7	2.9	11.9	1.3	.4	.1	36.3	2.3
14. Iron & Steel (12)	12	12	12	16	18	4.9	.6	.8	.7	5.4	2.1	.9	.4	5.4	15
15. Printing & Publishing (16)	16	16	16	14	14	28.3	0	0	0	50.2	0	26.8	0	52.6	9
16. Metal Mining (21)	22	15	21	10	9	0	22.3	0	1.5	1.2	9.2	0	4.6	82	12
17. Chemicals (15)	17	17	16	14	17	8.1	13.1	3.6	7.6	14.9	8.1	.7	13.9	18	35
18. Non-Metallic Minerals (18)	18	18	18	18	11	18.2	9.6	.6	2.1	4.5	6.4	8.3	5	53.5	25
19. Agriculture & Forestry (17)	14	19	17	19	16	6.1	3.1	.9	3.3	.3	9.5	6	7.2	1.9	32
20. Non-Ferrous Metals (20)	20	22	20	22	13	6.5	5.5	0	7.6	1.8	6.1	1.6	4.6	20.7	46
21. Paper & Products (22)	21	21	22	21	15	1	20.1	23.4	8.8	4.3	15.4	11.4	.3	18.7	6.9
22. Petroleum & Coal Products (19)	19	20	19	20	23	.1	8.7	.1	6.4	.1	13.6	7.7	26.9	.6	42
23. Services (23)	24	23	23	23	22	19.6	9.6	.5	1.9	17.7	2.8	0	5.1	2.9	27
24. Coal Mining, Petroleum & Natural Gas (24)	23	24	24	24	24	1.9	20.4	1.9	15	.2	10.5	0	31	0	84

Note: Numbers in brackets are those of Table 3.1 of this study.

$$t_i = \frac{1}{X_i} \sum_{j>i} X_{ij} \; (i=1, 2, \ldots 24); \quad t_j = -\frac{1}{X_j} \sum_{i<j} X_{ij} \; (j=1, 2 \ldots 24).$$

average or "compromise" ranking.

In order to examine the similarity of hierarchical patterns among countries a Spearman rank correlation is computed for all possible pairs of countries. The results are as follows:

Japan - Norway	.81
Japan - U.S.A.	.90
Japan - Italy	.86
Japan - Canada	.62
Canada - Norway	.67
Canada - U.S.A.	.64
Canada - Italy	.59
U.S.A. - Norway	.89
Italy - Norway	.90
Italy - U.S.A.	.87

These correlation coefficients suggest that the ranking of sectors is very similar in all countries. All coefficients are significant at the 1% level.

If we were to compare the results obtained from the triangulation of the five matrices with those obtained from the classification of sectors of the type of tables 3.3 to 3.7 we observe that there is a close similarity between the pattern of interdependence of sectors as revealed by the triangulation of the five matrices and the sequence of categories I (Intermediate Primary Production) and III (Final Manufacture). All sectors in category III for example, and for all countries, are found to be ranked before all sectors

in category I. This is to be expected, since the method of triangularizing the matrices was based on the strength of either the u_j or w_i indexes and this was also the basis on which sectors were classified in tables 3.3 to 3.7. Triangulation of the input-output matrices, however, has the advantage of ranking each sector individually instead of just the categories as in the said tables. Thus a clearer picture is drawn with regard to the sectors which are closest to final demand and which depend more heavily on intermediate goods, and the sectors that depend exclusively on primary factors. The triangulation method, in other words, facilitates the choice of sectors that are more likely to start an industrialization and therefore a development process in an area. Such sectors could be particularly useful in areas where a market for their products exists locally because of a reasonable population density and/or income levels, for example, or where markets could be easily reached because of transportation facilities existing in these areas. Such areas could have been experiencing a lack of development because they depend on just one or two industries which though very large are of the type that have weak "backward" linkages (mining industries e.g.), and could not therefore start a development process.

Often such mining industries are heavy exporters and their production is therefore greatly affected by changes in foreign demand. But any changes in their production have severe and direct repercussions on the economy of the areas

in which they are located. The recent slack in the international nickel markets caused the two nickel factories in the Sudbury area to cut their labor requirements by up to 30%. Since the two factories are by far the most important employers in the area, the economy of the area now faces a more severe employment problem than the rest of the country. An industry such as the "transportation equipment" industry, found to be near the top of the triangular table, could in this particular case be of great help at least in the long run. Whether the industry produces trucks, cars or railroad equipment it is of the type that is most likely to draw in supplier industries that themselves could be users of intermediate inputs. Even snowmobile production could be a very promising start.

A second observation that can be made on the basis of the relationship between the triangulation and the classification method followed in tables 3.3 to 3.7 is that category II (Intermediate Manufacture) does not follow a specific ranking but overlaps both categories. This also is to be expected since its member industries being heavy buyers and sellers of intermediate inputs and outputs buy and sell from and to other industries located up or down the hierarchical ladder.

It is worth emphasizing once more the role played by the industries located at the two ends of the pyramid. The industry at the top is highly dependent on other industries for its inputs. But it sells nothing to other industries; its

total output goes to final demand (including exports). At the other extreme, the industry located at the bottom, as for example the coal mining industry, buys little or nothing from other industries in the processing sector. Most of its total output is sold to other processing sectors however.

An increase in demand for the products of an industry located at the bottom of the pyramid will hardly have any effect on the production of the industries above it. The effects of an increase in demand for the products of the industry located at the top, however, will spread through the economy from higher to lower sectors. That is, this industry has a strong activating effect on the sectors located below it whenever the demand for its product is increased. Such an effect could result, for example, from the establishment of a "transportation equipment" industry in an area. This industry, shown at the top of the pyramid when the "compromise" ranking is considered, is highly dependent on other sectors such as steel, machinery, rubber products, services and so on. The industry therefore could act as a strong magnet and attract at least some of the supplier industries close to where it is located. Since most of its supplier industries are of the type that themselves have relatively strong backward linkages and could therefore attract their own supplies, the probability that the "transport equipment" industry will be a good nucleus for further industrialization is fairly high.

In addition to the role that an industry, located at or near the top of the pyramid, can play in starting industrialization, it can also be considered in cases where economic recovery is the goal. Since such industry or industries can activate the group of industries located below them in the pyramid, an increase in consumption of their products could have much stronger effects in reactivating a depressed economy than would be the case if the increase in final demand was for the products of industries not so strong in "backward" linkages.

As was explained in chapter II, the indexes discussed so far, namely the u_j and w_i, do not take into consideration the indirect effects of an expansion of an industry upon the rest of the economy. The indexes that can be used when such repercussions are examined, are those that are derived from the inverse input-output matrix. These were an index of the "power of dispersion" an index of the "sensitivity of dispersion" and two indexes of "variance." They are repeated here for convenience.

Power of Dispersion $$D_j = \frac{\frac{1}{n} Z_j}{\frac{1}{n^2} \sum_j Z_j} \qquad (j = 1, \ldots, 24)$$

Sensitivity of Dispersion $$S_i = \frac{\frac{1}{n} Z_i}{\frac{1}{n^2} \sum_i Z_j} \qquad (i = 1, \ldots, 24)$$

Indexes of variance:

$$V_j = \frac{\sqrt{\frac{1}{n-1} \sum_i \left(Z_{ij} - \frac{1}{n} \sum_i Z_{ij}\right)^2}}{\frac{1}{n} \sum_i Z_{ij}} \quad (j=1,2,\ldots, 24)$$

and

$$V_i = \frac{\sqrt{\frac{1}{n-1} \sum_j \left(Z_{ij} - \frac{1}{n} \sum_j Z_{ij}\right)^2}}{\frac{1}{n} \sum_j Z_{ij}} \quad (i=1,2, \ldots, 24)$$

The comparability of these indexes, is also affected by the country differences that affected the cruder indexes u_j and w_i.

Index D_j (power of dispersion of industry j) is similar to the u_j index in the sense that it measures the effect that industry j has on its supplier industries. It can therefore be considered as the "backward" linkage effect of industry j. Unlike u_j however, index D_j is more inclusive since it considers not only the effect that industry j has on its direct suppliers but also the effect that it has on industries selling inputs to its suppliers. Table 3.11 shows the values of index D_j for the countries and industries examined in this study.

The index that resembles w_i is the S_i or "sensitivity of dispersion" index. Here again, index S_i is more inclusive than w_i. It not only considers the effect that industry i has on its direct customer industries but also the effect that it has on the industries that buy from its customers.

TABLE 3.11

INDEXES OF THE POWER OF DISPERSION D_j

Industry	Japan	Italy	U.S.A.	Norway	Canada
1	1.45	1.43	1.17	1.24	1.09
2	1.28	1.21	1.24	1.27	1.15
3	.88	1.14	1.36	1.12	1.29
4	.75	.82	1.79	.69	.79
5	1.10	1.24	1.43	1.40	1.42
6	.70	.70	.78	.68	.74
7	.96	1.11	.92	.92	.87
8	1.24	1.20	1.20	1.01	1.04
9	1.03	1.16	1.09	1.04	1.04
10	1.27	1.40	1.14	1.42	1.03
11	1.23	1.06	1.04	1.10	1.02
12	1.40	1.46	1.16	1.09	1.00
13	.95	.94	.93	.92	.95
14	.99	1.21	.96	1.09	1.08
15	1.05	1.17	1.18	1.20	1.09
16	1.04	1.10	.94	1.08	1.01
17	.65	.74	1.09	.81	.87
18	.75	.59	.76	.67	.81
19	1.08	.89	1.05	1.00	1.10
20	.94	1.13	1.30	1.40	1.11
21	.80	.69	.72	.66	.80
22	1.11	1.10	1.16	1.14	1.12
23	.87	.60	.76	.75	.88
24	.76	.61	.65	.83	.70

Note: The figures have been calculated from relation 2.8. The numbering of industries is in accordance with Table 3.1.

Table 3.12 shows the values of S_i index. In order to show more clearly which industries have relatively high and which have relatively low values for the two indexes we will apply the two way classification used for u_j and w_i. These classifications are shown in table 3.13 to 3.17.

On the basis of the classifications made in tables 3.13 to 3.17 we are now able to make two types of comparisons. Firstly one can compare the Canadian D_j, S_i table to those of the other four countries and secondly, we can compare the D_j, S_i and the u_j, w_i tables for each of these countries.

The first type of comparisons should tell us whether the similarities between the production structure of Canada and those of the other countries as revealed by the D_j, S_i indexes, are still as evenly spread as was indicated by the u_j, w_i measures, or whether these similarities are stronger among some pairs of countries and weaker among others in the group.

It is possible that since the D_j, S_i indexes measure not only the direct but also the indirect linkage effects of our industry on the rest of the economy, they may take into account industry relationships that could cause greater similarities among some but not all countries. Such relationships could not have been considered when the cruder u_j, w_i indexes were used.

The second type of comparisons that is that between the D_j, S_i and u_j, w_i indexes should indicate whether or not industries shown to have relatively strong "backward" and

TABLE 3.12

INDEXES OF SENSITIVITY OF DISPERSION S_i

Industry	Japan	Italy	U.S.A.	Norway	Canada
1	.55	.56	.67	.61	.63
2	.79	.80	.79	.87	.83
3	.63	.79	.92	.66	.78
4	.53	.56	.57	.95	.63
5	.60	.73	.76	.77	.79
6	.96	.79	1.24	1.18	2.71
7	.54	.67	.69	.62	.66
8	.57	.56	.80	.71	.98
9	.66	.68	.64	.63	.69
10	1.82	1.94	1.28	1.71	1.51
11	.82	.88	.97	.71	.79
12	3.10	2.29	1.52	1.33	1.35
13	.65	.69	.68	.67	.68
14	.72	.86	.93	.86	.79
15	1.61	2.26	1.54	1.42	1.00
16	1.04	.54	.72	.84	.73
17	.65	2.63	2.31	2.51	1.83
18	.55	.68	.68	.72	.66
19	.75	.87	.85	.73	1.16
20	1.07	1.09	1.15	1.38	.79
21	.69	.72	.73	.88	.85
22	1.36	.89	1.36	1.25	1.12
23	1.12	1.08	1.22	1.11	1.07
24	1.20	.97	1.03	1.12	.97

Note: The figures have been calculated from relation 2.9.

TABLE 3.13

CLASSIFICATION OF INDUSTRIES IN JAPAN BASED ON D_j & S_i VALUES

	Final $S_i < 1$				Intermediate $S_i > 1$			
Manufacturing $D_j > 1$	III Final Manufacture		D_j	S_i	II Intermediate Manufacture		D_j	S_i
	1.	Apparel	1.45	.55	10.	Textiles	1.27	1.82
	2.	Leather & Products	1.28	.79	12.	Iron & Steel	1.40	3.10
	5.	Grain Mill Products	1.10	.60	15.	Chemicals	1.05	1.61
	8.	Transport Equipment	1.24	.57	16.	Printing & Publishing	1.04	1.04
	9.	Rubber Products	1.03	.66	22.	Paper & Products	1.11	1.36
	11.	Machinery	1.23	.82				
	19.	Petroleum & Coal Products	1.08	.75				
Primary Production $D_j < 1$	IV Final Primary Production		D_j	S_i	I Intermediate Primary Production		D_j	S_i
	3.	Processed Food	.88	.63	20.	Non-Ferrous Metals	.94	1.07
	4.	Fishing	.75	.53	23.	Services	.87	1.12
	6.	Transport & Trade	.70	.96	24.	Coal Mining Petroleum & Natural Gas	.76	1.20
	7.	Industry n.e.c	.96	.54				
	13.	Non Metallic Mineral Products	.96	.65				
	14.	Lumber & Wood Products	.99	.72				
	17.	Agriculture & Forestry	.65	.65				
	18.	Non Metallic Minerals	.75	.55				
	21.	Metal Mining	.80	.69				

Note: Data are taken from Tables 3.11 and 3.12 of this study.

TABLE 3.14

CLASSIFICATION OF INDUSTRIES IN ITALY BASED ON D_j & S_i VALUES

	Final $S_i < 1$				Intermediate $S_i > 1$			
Manufacturing $D_j > 1$	III Final Manufacture		D_j	S_i	II Intermediate Manufacture		D_j	S_i
	1.	Apparel	1.43	.56	10.	Textiles	1.40	1.94
	2.	Leather Products	1.21	.80	12.	Iron & Steel	1.46	2.29
	3.	Processed Food	1.14	.79	15.	Chemicals	1.17	2.26
	5.	Grain Mill Products	1.24	.73	20.	Non-Ferrous Metals	1.13	1.09
	7.	Industry n.e.c.	1.11	.67				
	8.	Transport Equipment	1.20	.56				
	9.	Rubber Products	1.16	.68				
	11.	Machinery	1.06	.88				
	14.	Lumber & Wood Products	1.21	.86				
	16.	Printing & Publishing	1.10	.54				
	22.	Paper & Products	1.10	.89				
Primary Production $D_j < 1$	IV Final Primary Production		D_j	S_i	I Intermediate Primary Production		D_j	S_i
	4.	Fishing	.82	.56	17.	Agriculture & Forestry	.74	2.63
	6.	Transport & Trade	.70	.79	23.	Services	.60	1.08
	13.	Non Metallic Mineral Products	.94	.69	24.	Coal Mining Petroleum & Natural Gas	.61	.97
	18.	Non Metallic Minerals	.59	.68				
	19.	Petroleum & Coal Products	.89	.87				
	21.	Metal Mining	.69	.72				

Note: Data taken from Tables 3.11 and 3.12 of this study.

TABLE 3.15

CLASSIFICATION OF INDUSTRIES IN U.S.A.
BASED ON D_j & S_i VALUES

	Final $S_i < 1$				Intermediate $S_i > 1$			
	III	Final Manufacture	D_j	S_i	II	Intermediate Manufacture	D_j	S_i
Manufacturing $D_j > 1$	1.	Apparel	1.17	.67	10.	Textiles	1.14	1.28
	2.	Leather & Products	1.24	.79	12.	Iron & Steel	1.16	1.52
	3.	Processed Food	1.36	.92	15.	Chemicals	1.18	1.54
	5.	Grain Mill Products	1.43	.76	17.	Agriculture & Forestry	1.09	2.31
	8.	Transport Equipment	1.20	.80	20.	Non-Ferrous Metals	1.30	1.15
	9.	Rubber Products	1.09	.64	22.	Paper & Products	1.16	1.36
	11.	Machinery	1.04	.97				
	19.	Petroleum & Coal Products	1.05	.85				
	IV	Final Primary Production	D_j	S_i	I	Intermediate Primary Production	D_j	S_i
Primary Production $D_j < 1$	4.	Fishing	.79	.57	6.	Transport & Trade	.78	1.24
	7.	Industry n.e.c.	.92	.69	23.	Services	.76	1.22
	13.	Non Metallic Mineral Product	.93	.68	24.	Coal Mining Petroleum & Natural Gas	.65	1.03
	14.	Lumber & Wood Products	.96	.93				
	16.	Printing & Publishing	.94	.72				
	18.	Non Metallic Minerals	.76	.68				
	21.	Metal Mining	.72	.73				

Note: Data taken from Tables 3.11 and 3.12 of this study.

TABLE 3.16

CLASSIFICATION OF INDUSTRIES IN NORWAY
BASED ON D_J & S_i VALUES

	Final $S_i < 1$				Intermediate $S_i > 1$			
	III Final Manufacture		D_j	S_i	**II Intermediate Manufacture**		D_j	S_i
Manufacturing $D_j > 1$	1.	Apparel	1.24	.61	10.	Textiles	1.42	1.03
	2.	Leather & Products	1.27	.87	12.	Iron & Steel	1.09	1.33
	3.	Processed Food	1.12	.66	15.	Chemicals	1.20	1.42
	5.	Grain Mill Products	1.40	.77	20.	Non-Ferrous Metals	1.40	1.38
	8.	Transport Equipment	1.01	.71	22.	Paper & Products	1.14	1.25
	9.	Rubber Products	1.04	.63				
	11.	Machinery	1.10	1.01				
	14.	Lumber & Wood Products	1.09	.86				
	16.	Printing & Publishing,	1.08	.86				
	19.	Petroleum & Coal Products	1.01	.73				
	IV Final Primary Production		D_j	S_i	**I Intermediate Primary Production**		D_j	S_i
Primary Production $D_j < 1$	4.	Fishing	.69	.95	6.	Transport & Trade	.68	1.18
	7.	Industry n.e.c.	.92	.62	17.	Agriculture & Forestry	.81	2.51
	13.	Non Metallic Mineral Products	.92	.67	23.	Services	.75	1.11
	18.	Non Metallic Minerals	.67	.72				
	21.	Metal Mining	.66	.88				

Note: Table based on data from Tables 3.11 and 3.12

TABLE 3.17

CLASSIFICATION OF INDUSTRIES IN CANADA

BASED ON D_j & S_i VALUES

	Final $S_i < 1$				Intermediate $S_i > 1$			
		III Final Manufacture	D_j	S_i		II Intermediate Manufacture	D_j	S_i
Manufacturing $D_j > 1$	1.	Apparel	1.09	.63	10.	Textiles	1.03	1.51
	2.	Leather & Products	1.15	.83	12.	Iron & Steel	1.00	1.35
	3.	Processed Food	1.29	.78	15.	Chemicals	1.09	1.00
	5.	Grain Mill Products	1.42	.79	19.	Petroleum & Coal Products	1.10	1.16
	8.	Transport Equip - ment	1.04	.98	22.	Paper & Products	1.12	1.12
	9.	Rubber Products	1.04	.69				
	11.	Machinery	1.02	.79				
	14.	Lumber & Wood Products	1.08	.79				
	16.	Printing & Publishing	1.01	.73				
	20.	No-Ferrous Metals	1.11	.79				
		IV Final Primary Productions	D_j	S_i		I Intermediate Primary Production	D_j	S_i
Primary Production $D_j < 1$	4.	Fishing	.79	.63	6.	Transport & Trade	.74	2.71
	7.	Industry n.e.c.	.87	.66	17.	Agritculture & Forestry	.87	1.83
	13.	Non Metallic Mineral Products	.95	.68	23.	Services	.88	1.07
	18.	Non Metallic Minerals	.81	.66				
	21.	Metal Mining	.80	.85				
	24.	Coal Mining Petroleum & Natural Gas	.70	.97				

Note: Table based on data taken from Tables 3.11 and 3.12.

"forward" linkages when measured by the u_j, w_i indexes are also the sectors indentified as such when the more comprehensive indexes are used. This would give us an idea as to how close the u_j, w_i indexes come to measuring the total (i.e. direct plus indirect) linkage effects of an industry and whether they can be used as substitutes for the D_j, S_i indexes.

To see how strong the structural similarities are between Canada and each of the other countries and to be able to compare the results with that obtained with the u_j, w_i indexes, we will follow the method of comparison used when these latter indexes were examined. That is, we will compute the percentage of sectors that are present in the same category (i.e. categories I to IV of tables 3.13 to 3.17) for each pair of countries that includes Canada. This percentage is computed on the basis of the average number of sectors in each category for each pair of countries. The results of these computations are tabulated along with those obtained in the u_j, w_i case. They are illustrated in Table 3.18, A and B.

If we start with the comparisons among the five countries, we observe, on the basis of table 3.18 B, that except for the pair Canada-Norway, all other pairs of countries show about the same similarities. That is, there is no pair of countires, except for Canada-Norway, that has consistently higher percentage values than any other. With the exception, therefore, of the pair Canada-Norway the results for the other country pairs are consistent with the

TABLE 3.18

PERCENTAGE OF INDUSTRIES PRESENT IN THE SAME CATEGORY FOR EACH PAIR OF COUNTRIES

A

(Based on u_j, w_i indexes)

Countries / Categories	Canada Japan	Canada Italy	Canada U.S.A.	Canada Norway
I	40%	54%	40%	40%
II	92	87	87	87
III	71	71	83	92
IV	22	29	40	50

B

(Based on D_j, S_i indexes)

Countries / Categories	Canada Japan	Canada Italy	Canada U.S.A.	Canada Norway
I	33%	33%	66%	100%
II	80	88	79	80
III	71	86	78	90
IV	65	67	76	90

Note: Percentages are calculated on the basis of data from tables 3.3 to 3.7 and 3.13 to 3.17.

results obtained when the u_j, w_i indexes were used.

In the case of "Canada-Norway," the greatest similarities are observed in categories I and IV, that is the categories of "Intermediate Primary Production" and "Final Primary Production" respectively.

Before we attempt to explain these similarities we must note that the "coal mining, petroleum and natural gas" industry is missing from the Norwegion classification of industries.[1] Such an absence could affect the observed similarities in any of the four groups had this industry been present.

Having considered this source of possible error we can look now at categories I and IV.

The similarity of industry 6 (transport and trade) in the five countries can be explained by the fact that this industry consists of two subindustries which if taken separately each would show forward linkages of different strength in different countries but when these subindustries are aggregated to form the bigger industry these differences cancel out causing the new bigger industry to show a forward linkage value which is more comparable to that of the corresponding (bigger) industries in the other countries. For example, the "transport" part of the industry is expected

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[1]The absence of this industry from the list of industries in this study, is due to the absence of the "petroleum and natural gas" subindustry in the Norwegian list. This last chance would make the aggregated "coal mining, petroleum and natural gas" industry least comparable to that of the other countries and therefore the aggregated industry is dropped altogether.

to show low S_i (forward) value for Norway since most transport services in Norway are of the ocean shipping type and Norway is known to sell such services to other countries. This selling of services is an export and is therefore tabulated as final demand in Norway's input-output model and this gives this subsector a low S_i for Norway. On the other hand Canada's main customers of transport services are other Canadian industries (most probably due to the large distances within Canada) and not final demand sectors, whether domestic or foreign. This fact makes the "transport" subsector to show a high S_i (forward linkage) value for Canada. To compensate for such differences in S_i values of the "transport" subindustry the "trade" subindustry is most probably showing opposite differences in the values of this index. That is Canada must be exporting a higher proportion of the output of the "trade" industry relative to Norway. This would result in Canada having a low S_i value for this subsector which then compensates for the high Canadian S_i value for the "transport" subsector. The opposite must be the case for Norway.

These conclusions are not based on a clear evidence arising from input-output table observations. The conclusions could be justified however, on the basis of general observations on the economic activities of the two countries.

The next industry appearing in category I in both countries, is the "agriculture and forestry" industry. This industry is also found in category I for Italy. In fact the two countries where the "agriculture and forestry" is not a

member of category I, are the United States and Japan. In the first of these two countries, the industry is classified in category II because, as was explained earlier in this chapter, U.S. farmers and foresters make greater use of intermediate inputs such as services which give that industry a higher "backward" linkage strength in the U.S. than is the case in the other countries.

In Japan on the other hand the industry shows weak "forward" linkage effect probably because of the greater consumption of less processed agricultural products.

These observations with regards to the U.S. and Japan point to the conclusion that there is nothing special about the relationship of the Canadian and Norwegian productive structure that would cause the "agriculture and forestry" industry to fall in the same category in both countries. The special circumstances are rather present in Japan and the United States and seem to be mainly due to differences in income levels. The low per capita income in Japan that causes consumption of less processed agricultural products and the high per capita income coupled with the possibility of a greater variety of agricultural and forestry products that may require relatively more intermediate inputs in the U.S., cause the shifting of that industry to categories other than I. Canada and Norway on the other hand fall in the middle of the road on both counts, a fact that cause their "agriculture & forestry" industry to show high "forward" but low "backward" measures. The case is the same for Italy

and most probably for many other western countries.

There is little that can be said about the third industry in the group. The "service" industry is located in category I in all countries and therefore there does not seem that a special relationship between Canadian and Norwegian structures of production has caused this similarity.

In short, none of the above three cases seems to indicate any special similarity in the production structure of the two countries.

Looking now at category IV, which also shows a high similarity between Canada and Norway, we observe that out of the five industries that are common for the two countries four industries are members of category IV for all countries. It seems therefore that the greater similarity observed for category IV in the case of the pair Canada-Norway is not so much the result of the industries included in it as it is the result of the industries excluded from this category in the two countries but included in it in other countries. This means that if there are any stronger structural similarities between Canada and Norway, such similarities must be looked for in categories other than IV. But the remaining categories II and III do not show any greater similarity between this pair of countries as compared to any of the other three pairs.

The general conclusion that can be drawn for the pair Canada-Norway is that although the pair at first

appeared to show greater structural similarity than any other pair, a closer examination of groups I and IV which have caused such appearance revealed no special similarity of production structure between the two countries.

A second major observation that can be made on the basis of the comparison of D_j, S_i tables among the five countries is that the percentage of sectors that are the same is much greater in categories II and III. It will be remembered that this same observation was made in the case where the u_j, w_i tables (tables 3.3 to 3.7) were compared. In other words categories II and III are still the most stable categories even when the more comprehensive D_j, S_i indexes were used.

When we now compare the D_j, S_i and u_j, w_i tables for each country, we observe a general shifting of sectors from categories II and I towards categories III and IV in the D_j, S_i tables. In other words, when the D_j, S_i indexes are used to measure linkage effects, industries which have shown strong "forward" effects when these effects were measured by the w_i index are now showing that their forward effect, as measured by the S_i index, has weakened. This can only mean that of any attracting effects that an industry may have on its customer, these effects do not go beyond their immediate customers. If they did the S_i index that measures the effects of an industry not only on its customer industries but also on its customers' customers, would have been strong.

The following are some of the industries that have shifted.

Industry No. 5 (grain mill products) has shifted in all countries from category II (Intermediate Manufacture) to category III (Final Manufacture). This is an example of an industry whose products do not go many steps in the processing ladder after they leave the industry. They are rather headed for one, possibly two steps only before they reach final consumption. When the w_i index is used the next processing step counts very much thus giving the index a high value but when the S_i index is used this next step is only one in many that can affect the index. If following higher steps are missing then the S_i index will have a low value while the w_i index which measures only the first higher processing step after the product leaves the "grain mill products" industry will maintain its high value. "Metal mining" and "coal mining" are two more industries that shift from a high to a low "forward" linkage value when the S_i is substituted for the w_i index. This shift could be taken as an indication that their "forward" effects do not go beyond their immediate customer industries after which they drop to very low values because the products of such customers head for final demand and most probably for the export sector of final demand. In fact in the case of Canada the products of the "metal mining" industry goes mainly to final demand, a high proportion of which is export demand. Thus this industry shows low "forward" linkage effect even when the w_i index is

used as a measure.

What can now be said about the ability of the u_j, w_i indexes to substitute for the more comprehensive D_j, S_i indexes? As far as the u_j index is concerned it does seem to be a very good substitute for the D_j index. Sectors that were found to have relatively high u_j values were also found to have high D_j values. The u_j index therefore can be considered to be (on the basis of these findings) as good a measure of the "backward" effect of an industry as is the D_j index. With respect to the "forward" linkage effect, however, the w_i index seem to overestimate the strength of the linkage as it can be seen from the shift of sectors from high to low "forward" values when the S_i instead of the w_i index is used.

If we now, on the basis of the above analysis, were to construct a list of industries that are most likely to generate further industrialization in their area, we would, as in the case of the simpler u_j, w_i indexes, have a list of industries whose main characteristic is their relatively strong "backward" linkage effect, now measured by the D_j index.

As in the case of table 3.9 the list will include only those industries that are in categories II and III for all countries without exception. Table 3.19 is such a list of industries.

TABLE 3.19

INDUSTRIES MOST LIKELY TO GENERATE FURTHER INDUSTRIALIZATION.[1]

1.	Apparel	11.	Machinery
2.	Leather & Products	12.	Iron & Steel
5.	Grain Mill Products	15.	Chemicals
8.	Transport Equipment	19.	Petroleum & Coal Products
9.	Rubber Products	20.	Non-Ferrous Metals
10.	Textiles	22.	Paper Products

A comparison of tables 3.9 and 3.19 shows that both tables contains the same industries. Actually industries 19 and 20 should not have been included in table 3.19 since industry 19 is missing from categories II and III for Italy and industry 20 is not in these two categories in Japan. The Japanese case however shows values close to the average D_j, S_i for that country and is therefore a borderline case. Both of these industries are in categories II and III for Canada regardless of the indexes used.

This close similarity between tables 3.9 and 3.19 show more clearly the substitutability of the u_j for the D_j indexes. Since both tables were based on the strength of

[1]Table 3.19 is based on the classification of industries in Tables 3.13 to 3.17.

the "backward" linkage effect of industries and since both tables are the same it means that the u_j and D_j indexes are equivalent or almost equivalent for measuring this effect.

The classification of sectors used in tables 3.13 to 3.17 were based on the relative strength of the "backward" D_j, and "forward S_i, indexes. The classification made no attempt to separate these industries that in addition to showing high "backward" effects have the characteristic of drawing their inputs evenly from the country's industrial system. These are the industries that were named "Key Industries" by Rasmussen.

Such industries have been defined in chapter II as those that have relatively high D_j and relatively low V_j values, where V_j is an index of variance indicating how evenly or unevenly an industry draws its inputs from the industrial system. A high V_j value indicates that industry j buys most of its inputs from only a small number of other industries.

We wish now to identify Rasmussen's "Key Industries" and to see how they compare to the industries in table 3.19 that is to industries that have been found most useful to economic development. To do that we need to tabulate the V_j indexes for all industries and all countries. This is done in table 3.20.

On the basis of table 3.20 and table 3.13, we can now form a list of "Key Industries" for each country. Each list will consist of industries that have a D_j value greater

than one and a V_j value lower than the average V_j value for the country examined. That is, if a country's average V_j index equals to V_j 3.30 e.g. then a Key industry for this country must have D_j and V_j values that satisfy the conditions $D_j > 1$ and $V_j < 3.30$. Table 3.21 contains a list of "Key Industries" for each country. It can be seen from table 3.21 that only five industries are key industries in all five countries. At the same time it is also observed that, with the exception of the "textiles" industry, each key industry is on the "Key" category in three out of the five countries. It can therefore be argued that even under this more restrictive definition of a "Key Industry" the comparison of such industries among the five countries shows that the structure of production of these countries is not dissimilar. The definition is more restrictive in this case because, here, in addition to choosing an industry that has strong "backward" effects, the choice is limited to only those industries that spread these effects more evenly on the supplier industries.

A type of industry that could be thought of as "Key Industry" in a slightly different sense than that of Rasmussen's is one that shows relatively strong "forward" linkage effects and at the same time shows a relatively more even distribution of such effects than other industries. For lack of a better term, such industries shall be called "Forward Key Industries." A list of this type of industry could be

TABLE 3.20

INDEXES OF VARIANCE V_j

Industry	Japan	Italy	U.S.A.	Norway	Canada
1	2.66	2.89	3.16	3.02	3.03
2	3.37	3.49	3.33	3.50	3.39
3	3.26	3.12	2.92	3.05	2.70
4	3.48	3.63	3.81	4.54	3.70
5	3.17	3.39	2.75	3.19	2.51
6	3.55	4.32	4.00	4.62	4.24
7	2.84	2.90	3.41	3.44	3.46
8	2.57	2.00	3.21	3.68	3.13
9	2.73	2.94	2.87	3.03	2.88
10	3.38	3.74	3.31	3.86	4.01
11	2.83	3.32	3.45	3.22	3.04
12	4.22	4.21	3.74	3.70	3.72
13	2.95	3.34	3.39	3.52	3.20
14	3.24	3.38	3.98	3.54	2.98
15	3.27	3.89	3.25	3.30	3.05
16	2.83	2.83	3.68	3.84	3.22
17	4.25	4.75	3.93	4.06	3.58
18	3.48	4.99	3.97	4.61	3.60
19	3.06	3.68	3.48	3.51	3.07
20	3.88	3.51	3.61	3.81	3.07
21	3.31	4.25	4.09	4.67	3.65
22	3.73	3.01	3.99	3.67	3.05
23	3.52	4.95	4.36	4.60	4.09
24	3.70	4.44	4.83	3.95	4.23
Average V_j	3.30	3.62	3.61	3.75	3.35

Note: The figures have been calculated from relation 2.10.

TABLE 3.21

KEY INDUSTRIES

Industry \ Country / Criterion	Japan $D_j > 1.00$ $V_j < 3.30$		Italy $D_j > 1.00$ $V_j < 3.62$		U.S.A. $D_j > 1.00$ $V_j < 3.61$		Norway $D_j > 1.00$ $V_j < 3.75$		Canada $D_j > 1.00$ $V_j < 3.35$	
	D_j	V_j	D_j	V_j	D_j	V_j	D_j	V_j	D_j	V_j
1. Apparel	1.45	2.66	1.43	2.89	1.17	3.16	1.24	3.02	1.09	3.03
2. Leather & Products	-	-	1.21	3.49	1.24	3.33	1.27	3.50	-	-
3. Processed Food	-	-	1.14	3.12	1.36	2.92	1.12	3.05	1.29	2.70
5. Grain Mill Products	1.10	3.17	1.24	3.39	1.43	2.75	1.40	3.19	1.42	2.51
8. Transport Equipment	1.24	2.57	1.20	2.00	1.20	3.21	1.01	3.68	1.04	3.13
9. Rubber Products	1.03	2.73	1.16	2.94	1.09	2.87	1.04	3.03	1.04	2.88
10. Textiles	-	-	-	-	1.14	3.31	-	-	-	-
11. Machinery	1.23	2.83	1.06	3.32	1.04	3.45	1.10	3.22	1.02	3.04
14. Lumber & Wood	-	-	1.21	3.38	-	-	1.09	3.54	1.08	2.98
15. Chemicals	1.05	3.27	-	-	1.18	3.25	1.20	3.30	1.08	3.05
16. Printing & Publishing	1.04	2.83	1.10	2.83	-	-	-	-	1.01	3.22
19. Petroleum & Coal Products	1.08	3.06	-	-	1.05	3.48	1.00	3.51	1.10	3.07
20. Non-Ferrous Metals	-	-	1.13	3.51	1.30	3.61	-	-	1.11	3.07
22. Paper & Products	-	-	1.10	3.01	-	-	1.14	3.67	1.12	3.05

NOTE: The values for D_j and V_j are taken from Tables 3.11 and 3.19.

TABLE 3.22

INDEXES OF VARIANCE V_i

Industry	Japan	Italy	U.S.A.	Norway	Canada
1	5.20	5.37	5.33	5.19	4.74
2	5.27	5.33	5.28	5.15	4.77
3	4.49	3.92	3.88	4.98	4.20
4	4.89	5.35	5.31	3.33	4.69
5	4.38	4.16	4.37	4.31	4.08
6	2.66	3.30	2.45	2.64	1.10
7	5.09	4.46	4.54	5.15	4.55
8	5.20	5.39	4.71	5.20	3.29
9	4.02	4.87	4.72	4.97	4.25
10	2.69	3.02	2.99	3.36	2.88
11	3.72	4.04	3.69	4.95	3.92
12	2.03	2.85	2.89	3.05	2.72
13	4.33	4.53	4.67	4.85	4.52
14	4.10	4.55	4.12	4.40	3.95
15	2.12	2.06	2.48	2.71	3.29
16	4.92	5.39	4.71	4.95	4.36
17	1.54	1.87	2.19	1.84	1.94
18	4.75	4.29	4.44	4.32	4.43
19	4.00	3.59	4.06	4.25	2.75
20	3.41	3.64	4.10	3.87	4.22
21	3.80	4.08	4.13	3.58	3.53
22	3.16	3.79	3.45	3.30	3.03
23	2.55	2.70	2.91	3.76	3.33
24	2.50	3.22	3.11	3.28	3.08
Column Average	3.78	3.99	3.94	4.06	3.65

Note: The figures have been calculated from relation 2.11.

fairly useful where price and income controls are deemed necessary. Instead of authorities applying controls indiscriminately, they could direct their attention to industries that, because of their importance as suppliers to the rest of the industrial system, could affect the price level in very many industries and therefore, most likely, in the economy as a whole.

In order to identify such industries we need to tabulate the values of the V_i index for all industries and all countries examined. This is done in table 3.22.

It will be recalled that a low V_i index indicates that the ith industry spreads its forward effects relatively smoothly throughout the spectrum of its customer industries.

On the basis of table 3.22 and table 3.12, which contains the corresponding S_i values, we are now able to form a list of "Forward Key Industries" for each country. Each list will consist of industries that have an S_i value greater than one, and a V_i value below the average V_i value for that country.[1]

The five lists are shown in table 3.23.

Table 3.23 shows that only four out of the ten industries in it are "Forward Key Industries" in all five countries. The comparability however, is better than it looks at first glance. With the exception of the "Petroleum and

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[1] Such average values are indicated at the bottom of Tables 3.12 and 3.21.

TABLE 3.23

FORWARD KEY INDUSTRIES

Industry \ Country / Criterion		Japan $S_i > 1.00$ $V_i < 3.78$		Italy $S_i > 1.00$ $V_i < 3.99$		U.S.A. $S_i > 1.00$ $V_i < 3.94$		Norway $S_i > 1.00$ $V_i < 4.06$		Canada $S_i > 1.00$ $V_i < 3.65$	
		S_i	V_i	S_i	V_i	S_i	V_i	S_i	V_i	S_i	V_i
6.	Transportation & Trade	.96	2.66	-	-	1.24	2.45	1.18	2.64	2.71	1.10
10.	Textiles	1.82	2.69	1.94	3.02	1.28	2.99	1.71	3.36	1.51	2.88
12.	Iron & Steel	3.10	2.03	2.29	2.85	1.52	2.89	1.33	3.05	1.35	2.72
15.	Chemicals	1.61	2.12	2.26	2.06	1.54	2.48	1.42	2.71	1.00	3.29
17.	Industry n.e.c.	-	-	2.63	1.87	2.31	2.19	2.51	1.84	1.83	1.94
19.	Petroleum & Coal Products	-	-	-	-	-	-	-	-	1.16	2.75
20.	Non-Ferrous Metals	1.07	3.41	1.09	3.64	-	-	1.38	3.87	-	-
22.	Paper & Products	1.36	3.16	-	-	1.36	3.45	1.25	3.30	1.12	3.03
23.	Services	1.12	2.55	1.08	2.70	1.22	2.91	1.11	3.76	1.07	3.33
24.	Coal Mining Petroleum and Natural Gas	1.20	2.50	-	-	1.03	3.11	-	-	.97	3.08

Note: The values for S_i and V_i indexes are taken from Tables 3.12 and 3.21.

Coal Products" industry, all other industries are "Forward Key Industries" in the majority of countries.

3. <u>The "Gamma" Index</u>

In the preceding comparisons it was shown that industries with relatively strong "backward" effects were more comparable than other industries. This conclusion was mainly based on direct observations on the similarity of membership of categories I to IV among the five countries.[1] There exists however, an alternative method of showing what types of industries are more comparable than others.

The method makes use of an index that was described in chapter II of this study and was named the Gamma index. The index measures differences between individual input coefficients of the same industries in two different countries. The smaller is the value of this index, the more similar are the two industries compared.

Using such an index one can examine similarities or differences among any type of industries and therefore similarities or differences among industries having relatively strong "backward" linkage effects. The method therefore could serve as a check on the results obtained earlier on "backward" linkage industries.

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[1]Categories I to IV refer to Tables 3.3 to 3.7 and 3.13 to 3.17 of this study.

This index is repeated here for convenience.

$$\gamma_j^{\alpha\beta} = \frac{\sum_i | a_{ij}^{\alpha} - a_{ij}^{\beta} |}{1/2 \sum_i (a_{ij}^{\alpha} + a_{ij}^{\beta})}$$

With the help of this index ten two-country comparisons are possible, each comparing the twenty-four industries listed in this chapter. The results of these comparisons are shown in table 3.24.

Two types of comparisons can be made on the basis of this table. Firstly, we could make a general comparison of similarities or differences in the production structure of the five countries. Secondly, we could make an examination of individual industries to see which industries are the most comparable as among the five countries.

In order to examine similarities among countries we could use the mean value for each column and look for the smallest such value. The two countries in a column showing the smallest mean value would then be considered as having the most similar production structure.

The mean of a column however could be affected by extreme values in each column. To avoid such an effect we shall use the median of a column as a measure of similarity in production. The rule is the same. The smaller the median of a column the more similar are the production structure of given industries in the two countries.

TABLE 3.24

GAMMA MEASURES[1]

Industry	I-J	I-U	J-U	N-J	N-I	N-U	C-J	C-I	C-U	C-N
1	.231	.784	.647	.567	.413	.625	.594	.496	.673	.242
2	.539	.234	.563	.578	.247	.246	.966	.722	.582	.727
3	.854	.481	.813	.477	.573	.550	.960	.633	.347	.683
4	.738	.654	.578	1.020	1.252	1.141	1.039	1.015	.879	1.049
5	.040	.824	.830	.139	.170	.688	1.099	1.104	.593	1.114
6	1.025	1.168	.614	1.064	1.136	.794	1.217	1.613	.850	1.084
7	1.094	.998	.525	--	--	--	1.116	1.323	.989	1.062
8	.424	.834	.733	1.811	1.029	.725	.564	.605	.557	.863
9	.735	.514	.393	.672	.614	1.016	.671	.930	.717	1.056
10	.282	.500	.495	.300	.132	.598	.835	.796	.879	.746
11	.503	.242	.454	.467	.331	.365	.773	.623	.636	.603
12	.203	.617	.593	.861	.865	.544	1.001	.951	.588	.664
13	.464	.594	.607	.692	.456	.665	.896	.811	.598	.688
14	.530	.790	1.102	.740	.523	.695	.643	.702	1.109	.658
15	.578	.602	.440	.647	.978	.654	.833	1.065	.728	.983
16	.325	.496	.426	.178	.366	.347	.800	.884	.499	.931
17	1.026	.765	1.249	.580	1.114	1.178	1.191	1.329	1.074	.966
18	1.057	1.371	1.017	1.181	.915	1.056	1.208	1.600	.996	1.373
19	.445	.715	.509	.742	.695	1.184	1.587	1.834	.991	1.727
20	.477	,594	.440	.470	.539	.352	.998	.975	.994	1.000
21	1.209	1.177	.972	1.690	1.067	.709	1.159	1.335	.957	1.049
22	1.145	.821	.397	.573	1.075	.686	.995	.968	1.219	.642
23	1.335	1.206	.929	.938	1.242	.673	1.475	1.633	.807	1.854
24	1.231	1.370	1.250	1.107	1.140	1.227	1.141	1.249	1.080	1.605

[1]Definition of this measure is given by equation

$$\gamma_j^{\alpha\beta} = \frac{\sum_i \left| a_{ij}^{\alpha} - a_{ij}^{\beta} \right|}{1/2 \sum_i (a_{ij}^{\alpha} + a_{ij}^{\beta})}$$

The following list shows the median between each pair of countries.

Italy - Japan	.58
Japan - U.S.A.	.65
Norway - U.S.A.	.69
Norway - Japan	.74
Italy - U.S.A.	.78
Norway - Italy	.79
Canada - Italy	.99
Canada - Japan	.98
Canada - U.S.A.	.75
Canada - Norway	.95

A look at this list shows that Italy and Japan are the most comparable pair. They have the smallest median. Canada on the other hand, seems to compare more with the U.S.A. than with any of the other countries. This greater comparability with the U.S. could on the one hand be attributed to a similarity in technology between the two countries but it could also be due to the greater similarity in the treatment of the classification of industries in the input-output tables of the two countries. No definite conclusion could therefore be made on the basis of this observation. Similarly the smaller comparability observed between Canada and Italy and Canada and Japan could be due to the different treatment of intersectoral transactions followed in these countries. As has been pointed out earlier, Japan uses the "activity" instead of the "establishment" as a basic unit of

classification. Thus intermediate products produced and used as inputs within the same establishment are recorded, in Japan, as intrasector transactions. This method of recording transactions has an effect on the value of the diagonal elements α_{ii} of the Japanese input-output matrise. This in turn influences the value of the " γ " index, therefore, the results of the comparisons between Japan and each of the other countries. Since Canada is using the establishment as a basic unit of classification, a discrepancy could result in the comparison of these two countries. Here again no definite conclusion can be made as to similarities or differences in the production structure of these three countries. Any conclusions are further weakened by the fact that unlike comparisons based on u_j, w_i and D_j, S_i indexes, comparisons using the " γ " index are more sensitive to differences in prices of inputs in the different countries. As mentioned earlier the " γ " index makes use of differences in "individual" coefficients. This being the case, it is difficult to invoke the law of averages to help us out as we did for the other indexes at the beginning of this chapter.

It is reassuring to know that in similar comparisons where the " γ" index was used, Chenery and Watanabe have found that "of the prices of the various inputs by far the most important difference is in that of labor."[1] Since we

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[1] H. B. Chenery & T. Watanabe, op. cit., p. 501.

make no comparisons of labor coefficients here, this means that differences in prices do not interfere very much in our case. There could be some interferences nevertheless, and such a possibility therefore must be kept in mind.

Such a possibility combined with the accounting discrepancies just mentioned tend to make us conclude that no particularly strong similarity or difference exist between any pair of countries and that therefore, Canada's production structure equally resembles that of any of the other countries.

In order now to examine whether certain types of industries are more comparable than others we shall classify all possible two country comparisons on the basis of the magnitude of the " γ " index of the industry and the type of the industry.

Since we are interested to see whether or not the strong "backward" linkage industries are more comparable than others, we shall divide industries into two types. One type will include relatively strong "backward" linkage industries which we shall call "Type A" industries while the second type will include all other industries which we shall designate as "Type B".

As "Type A" industries we shall consider only those included in tables 3.9 and 3.19. This is done for two reasons. Firstly, the industries included in these two tables are not only strongly "backward" linked industries, they are also the most comparable among such industries. The " γ " test in this case, will show whether or not such comparability

still holds when individual coefficients, rather than linkage indexes, are examined. Secondly, some industries in tables 3.9 and 3.19 are of the type considered to be most desirable for economic development and it is important to know whether or not these industries satisfy all possible tests of comparability. As was explained earlier it is easy in an affirmative case to choose an industry likely to develop an area without worrying as to whether or not the industry will succeed in area B when it was known to have succeeded in area A .

Table 3.25 shows the two types of industries for all countries considered. The table is an adaptation of Chenery and Watanabe's table VI[1]. But where the two researchers have used the terms "Manufacturing" and "Other" industries we have used the terms "Type A" and "Others." Their "Manufacturing" include all strongly "backward" linked industries. Our "Type A" however includes only those of the strongly "backward" industries that are such in all five countries. The term "Type A Industries" is therefore more restrictive.

The left-most column of table 3.25 includes four ranges of magnitudes of the "γ^{e}" index. The table shows the number of times that a comparison of different industries of a country with the corresponding industries in each of the other countries produces a "γ^{e}" index that falls within a certain range. For example, suppose we observe the number 18 in column A for Japan. Suppose also that the number 18 is situated across the range 0 - 0.499. This means that a

[1] *Ibid.*, p. 500.

categorized as "Key Industries" in the "backward" sense belong in type "A" industries.[1] This means that the Rasmussen type "Key Industries" are also of the most comparable type of industries.

4. Conclusions

Several conclusions can be drawn on the basis of the comparisons made in this chapter. One such conclusion is that Canada's production structure shows no special similarity or difference as compared with the production structure of any of the other four countries compared. It is in general fairly comparable with any of the ones examined. Any differences or similarities observed are not very pronounced and may be explained by similarities or differences in the methods of industry classifications and by the fact that no correction was made for price differences among countries.

The fact that Canada is closer to the United States than to any of the other countries compared does not seem to have led to a more similar economic structure as between the two countries. The fact that Canada has a large export sector relative to its national product does not result in any special similarity of the Canadian economy to that of the countries with similarly and relatively large export sectors.

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[1]This can be seen by comparing Tables 3.21 with Tables 3.9 or 3.19 of this study.

The main reason for such evenly spread similarities among the five countries seems to be the similarity in the technology used by these countries. It has been pointed out in several places in this chapter, where different types of industries were examined, that technology was the main reason for the comparability of some types of industries and not for others. Thus the greater relative comparability of industries having both strong "backward" and strong "forward" linkages was explained by the fact that these industries were more sensitive to technology than to final demand or sources of raw materials.[1] Their low sensitivity to the last two factors is due to the position these industries hold in the industrial hierarchy. They are located close to the middle of this hierarchy and are thus less affected by changes in final demand or sources of raw material. Since, however, these industries are users and suppliers of intermediate products and since such products are in the majority the results of existing technology it follows that when technology is different in different countries "Intermediate Manufacture" industries are also expected to be different. The fact that they are not indicates that the same technology was used in all countries examined.

Industries that are "Final Demand" or "Resource" oriented are also influenced by the technology but such

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[1]The reference here is to "Intermediate Manufacture" type industries i.e. to industries of category II in Tables 3.3 to 3.7 and 3.13 to 3.17.

influence is weaker compared to final demand and resource influences. Both of these factors differ in different countries causing a relatively weaker comparability of these industries.

This greater comparability of the "Manufacturing" as against the "Primary" type industries is the second conclusion arrived at in this chapter. This conclusion holds regardless of the type of indexes used to make the comparisons.

A third conclusion that can be drawn from the comparisons of this chapter refers to the substitutability of the u_j and w_i indexes for the D_j and S_i ones. The comparisons showed that the u_j index is a very good substitute for the more comprehensive but also more time consuming D_j index. This is a useful conclusion for cases where the "backward" linkage effects of an industry must be calculated but where a complete input-output table for the country or region does not exist. The u_j value can in this case be relatively easily obtained from available engineering data on the jth industry's inputs and output. Calculation of a D_j index, as it will be recalled from its descriptions in chapter II, requires a fairly complete input-output matrix.

This case of substitutability between simpler and more complex indexes does not hold in the case of the "forward" linkage effect of an industry. In this case the w_i index seem to overestimate the "forward" effect and therefore a

calculation of an S_i index is necessary when a more accurate estimation of the "forward" linkage effect of an industry is needed.

A general reflection on the results obtained in this chapter points to the fact that, for purposes of development of a region or a country, the "Manufacturing" type industries whether of the "Final" or "Intermediate" type are more desirable than "Primary" type industries.[1]

Whatever the value of "Primary" or "Resource" type industries for earning foreign exchange or for increasing the per capita income in their area through the multiplier effect, they seem to have two drawbacks. Firstly, their high capital intensity precludes great increases in labor employment even when the size of these industries is substantially increased.[2] Secondly if a permanent development of an area is desired, such industries cannot be relied upon to do the trick. Their low "backward" linkage effect cannot attract supplier industries, while their potential "forward" effect will not develop unless restrictions on exportation of their products are imposed. If one wants to be pessimistic, one can think of a sudden reduction in the production of such industries, a reduction that could come about by a saturation of world markets, a

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[1]"Final Manufacture" refers to industries classified in group III of Tables 3.3 to 3.7 and 3.13 to 3.17.

[2]See B.W. Wilkinson, Canada's International Trade: An Analysis of Recent Trends and Patterns (The Private Planning Associations of Canada February 1969), p. 101.

discovery of a similar resource in the previously importing countries, or a displacement of such products from world markets by products of a new technology. Such a reduction or possible termination of the operation of a "Primary" industry could cause severe depression in the area that depended on the industry. Had this been an industry of the type that attracts other industries, its life or death would not necessarily mean the life or death of the area in which it is located. The new productive activities created in the area, in this case, would cushion the loss of the original industry.

CHAPTER IV

METHODOLOGICAL AND STATISTICAL PROBLEMS INVOLVED IN INTERTEMPORAL COMPARISONS

It was pointed out in Chapter III that the international comparisons of industrial linkages had to be made without corrections for possible price differences among the countries examined. The main reason for this was the difficulty of constructing the appropriate price indexes for such a correction.

Although difficulties are also present in the construction of price indexes necessary for the intertemporal comparison of Canadian industries, it was thought that such difficulties were not as great as in the case of international comparisons (data are expected to be more homogeneous, for example, when only one country is examined). In this case the resulting indexes are expected to be relatively more accurate and their use could improve the comparability of linkages discussed in the following chapter.

In this chapter an attempt will be made to construct such price indexes.

A second task in this chapter is the reconciliation of the two Canadian input-output tables used for the comparisons of industrial linkages.

The input-output table completed in 1949 follows

closely the generally accepted form of a square matrix with one to one correspondence between industries and commodities. The 1961 Canadian model, however, abandons this form and uses instead a rectangular matrix with more commodities than industries. There is a need therefore for reconciliation of the two tables.

1. Price Indexes

Two types of price indexes and their variations are most frequently used to deflate data of one period in terms of another. These are the Laspeyres and the Paasche indexes.

The first uses as weights the base year value v_o of each item included in the index, where $v_o = p_o \cdot q_o$, i.e., v_o is the product of the price p_o of the item in the base year and its quantity q_o produced in that year.

The Paasche index uses as weights the value v_n of each item in the index. The difference is that v_n is the product $p_o \cdot q_n$. That is, it is the product of the quantity of the item produced in year n and its price in the base year o. In symbols the two indexes are expressed as

$$P_L = \frac{\sum_i v_o \cdot \frac{p_n}{p_o}}{\sum_i v_o} \qquad \text{and} \qquad P_p = \frac{\sum_i p_n \cdot q_n}{\sum_i p_o \cdot q_n}$$

where P_L refers to Laspeyres index while P_p refers to Paasche.

The advantage of Laspeyres index is that the weights are fixed and it is only the prices that change from year to year. The index P_p measures the change in cost of the quantities actually purchased from what the same quantities would have cost had they been purchased in the base year.

The Canadian price indexes constructed by the Dominion Bureau of Statistics (now Statistics Canada) use a variation of the Laspeyres formula.

2. Wholesale Price and Industry Selling Price Indexes

Ideally what one would hope to find, when attempting to compare two input-output tables for different time periods, is a price index series which (a) has a base year coinciding, or being very close to one of the periods and (b) uses the same classification of their component items as the one used by the two tables.

This ideal situation does not exist in the case of Canada. In 1950 a new series of Canadian price indexes using as a base the average between 1935 and 1939 (i.e. 1935-1939 = 100) replaced an earlier series having 1926 as base year (1926 = 100). "Chief Component Materials" was used in both series, as the standard of commodity classification. However, the classifications used in the two Canadian input-output tables are mainly classifications of enterprises. For this reason indexes referring to industries are more appropriate than those referring to commodities. Thus the General Wholesale Index and its

component series based on a "Chief Component Material" criterion, are unsatisfactory.

In 1961 Statistics Canada introduced a new series of wholesale price indexes under the name of "Industry Selling Price Indexes." According to the Bureau, "these indexes express the current composite price of shipments of commodities of Canadian manufacture as percent of the base year (1956) price equivalent which is taken as 100 percent."[1] The indexes correspond to the "Standard Industrial Classification" which is used in the Canadian input-output tables. This correspondence is the main distinction between the "Industry Selling Price Indexes" and the previously published wholesale price indexes.

The base weighting period of the new indexes was the year 1953. This year met most of the requirements for a base period. The Bureau's comments are that "Supplies of materials and manpower in manufacturing seemed to be adequate; the inflationary effects of the Korean conflict had largely subsided . . . . Finally, the level of activity in 1953 gave promise of a satisfactory perspective for a number of years."[2]

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[1]Dominion Bureau of Statistics, <u>Industry Selling Price Indexes 1956-59</u>, Catalogue No. 62-515, p. 7.

[2]Dominion Bureau of Statistics, <u>Indexes of Real Domestic Product by Industry (1961 Base)</u>, Cat. No. 62-515,1968, p. 8.

The year 1956 was selected as the base year because it was difficult to collect accurate prices prior to January 1956 and it was felt that difficulties would outweigh the benefits to be derived from indexes for earlier years.

The weights used in the calculations of the "Industry Selling Price Indexes" are based on total value of shipments of firms grouped in an industry. The indexes, are calculated according to the Laspeyres formula. Thus the weights are fixed for an extended period of time.

Industry selling price indexes as published by Statistics Canada are measures of prices received, by manufacturers for goods they sell and consequently elements of purchaser's price paid by other industries are not considered in the indexes. Thus freight, insurance and taxes are excluded from price quotations. The indexes therefore reflect producers' prices. This has the advantage of making the series more comparable than if they contained freight, insurance and taxes, which vary not only from industry to industry but also from time to time. Furthermore such series are more suitable for deflating the Canadian input-output tables which are also calculated on the basis of producers' prices.

There are two disadvantages in using these indexes for deflating the Canadian input-output tables as they are aggregated in this study.

Firstly the indexes do not include all industries classified in the input-output tables but only the manufacturing industries. Thus input-output sectors 1 to 6 and

37 to 42 of the 1949 Standard Industrial Classification, are not in the series and therefore they have to be calculated separately from other series available. This introduces an element of heterogeneity in the deflation of the tables since some sectors would be deflated by one series while others by other series. There is also the danger of leaving some commodities out of the indexes calculated separately, while these commodities are included in the new, i.e. the Industry Selling Price Indexes series. The calculation of weights of such fragmented series is difficult and the results are very doubtful.

The second disadvantage of the new series is that they use the year 1956 as a base year. To deflate the input-output tables, series having the year 1949 as a base would be needed since 1949 was the year of reference of the first of the two Canadian input-output tables compared.

To overcome this disadvantage, an attempt was made to project the series backwards to 1949. This was done by fitting a line through the available data from 1956 to 1965. Needless to say that this kind of projection was done only for the sectors included in the "Industry Selling Price Index" series.

While this index generation was in progress an alternative unpublished series was supplied by the Dominion

Bureau of Statistics.[1] The base year used in this series was the desired year 1949 but the series was extended only up to 1958.

At first it was thought that a linear projection up to 1961 would be sufficient and although an approximation it could serve as a good proxy for a 1961/1949 price relative. A comparison, however, between these series and those derived from the projections of the Industry Selling Price Indexes (for the year 1958) showed that a rather serious discrepancy existed between the two.

Thus the thought of using either one of these two series was abandoned and a new approach was used. The method is simply this. A quantity index[2] series produced by the National Accounts Division of Statistics Canada was used in conjunction with current dollar gross domestic production at factor cost and industry of origin.

The quantity index series using 1949 and 1961 as base years were contained in the "Indexes of Real Domestic Product by Industry (1961 Base)" respectively.

These two series included all or almost all the components of each industry as these industries were defined in the two input-output tables used. Furthermore they included

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[1]Letter from Mr. R. B. Hoffman, Chief, Customer Service and Analysis Section, Input-Output Research and Development Staff, Ottawa, Ontario, December 1, 1969.

[2]Dominion Bureau of Statistics, Indexes of Real Domestic Product by Industry (1961 Base), Cat. No. 61-506, 1968.

all industries but three, as these industries appeared in the 1949 Input-Output Table.

The three missing industries are

1. The group of (a) agricultural implements (1949 Input-Output number 27), (b) iron and steel products not elsewhere classified (1949 Input-Output number 28), (c) non-ferrous metal products not elsewhere classified (1949 Input-Output number 31).

2. The group of (a) jewellery and silverware (1949 Input-Output number 30), (c) miscellaneous manufacturing industries not elsewhere classified (1949 Input-Output number 36); and

3. Service industry (1949 Input-Output number 42).

The price index for the first group was constructed from linearly projecting the 1958 (1949 = 100) index provided by the D.B.S. to 1961 (1949=100) and using as weights for the three industries in this group, the weights provided in the "Indexes of Real Domestic Product by Industry."[1]

For Group No. 2 a simple average of the indexes of all industries was taken as the way out. This was made necessary by the fairly big discrepancy that existed between the projected index and that provided by Statistics Canada.

The index for the "services" industry was simply a linear projection to 1961 of the 1958 index (1949 = 100) provided by Statistics Canada as no other suitable data were available.

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[1] *Ibid.*, 35-44.

As mentioned the "Indexes of Real Domestic Product by Industry of Origin" are used in conjunction with current dollar industry output.

The "Current Dollar Gross Domestic Product at Factor Cost" of the relevant (for this study) industries was deemed to be a good proxy measure of an industry's total output. Furthermore, this measure seemed the more suitable one, since the real output indexes were also based on a real domestic product at factor cost.[1]

If such figures existed for the two years (1949 and 1961) the problem of calculating price indexes would be solved.

The Statistics Canada publication that has a fairly complete set of such data (complete in the sense that it covered most of the relevant industries), is the "General Review of the Manufacturing Industries of Canada" (1949 and 1961).[2] Unfortunately data on the basis of G.D.P. at factor cost was discontinued after 1952 and the basis for data was changed to "Value of Factory Shipments." An alternative was to use the data from the two Input-Output Tables. Since both tables contain figures giving the current dollar G.D.P. at factor cost they fitted the purpose.

The calculation of price indexes for each industry, from these two series of data is simple.

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[1]Dominion Bureau of Statistics, Indexes of Real Domestic Product by Industry 1935-61, Cat. No. 61-505,

[2]Dominion Bureau of Statistics, General Review of the Manufacturing Industries of Canada, Cat. No. 31-201.

We know the percentage change in real value of output of each industry. (This is given by the "Indexes of Real Domestic Product by Industry of Origins" series). We also know, or can calculate, the percentage change in value of output measured in current prices. (From the two Input-Output Tables).

Dividing the latter percentage figure by the former gives us the desired price index.

To illustrate:

Suppose the 1961 index of real output for agriculture (1949 = 100) is 115.2. Suppose also that the calculated increase of agricultural output in current prices is 109.2. The 1961 price index for agriculture (1949 = 100) is then $\frac{109.2}{115.2} = 94.5$. The index, in this case, shows a decline in the price of agricultural products.[1]

The actual calculations of price indexes was done by fixing the year 1961 as the base year and calculating the index backwards to give an index of 1949/61 price relatives.

Where aggregation of industries was necessary the index of the new aggregated industry was calculated as a weighted average of the indexes of the industries in the group. The weights were 1961 weights and were calculated in the series as percentages of the Canadian Real Domestic Product.

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[1] The figure of 109.2 was found by dividing the 1961 current dollar value of output in agriculture by the 1949 current dollar value of output in that industry and multiplying by 100; i.e. $\frac{1,749}{1,601} \times 100 = 109.2$

The choice of 1961 as a base year was thought to be an improvement in the sense that, if conditions of production have changed, the more recent quantities give a more realistic picture than quantities calculated several years before.

The basic data for calculating the Industry Price Indexes as well as the price indexes themselves are given in Table 4.3 at the end of this chapter. Price indexes are calculated using 1949 = 100 as well as using year 1961 = 100.

3. Deflation of Data

The method applied to deflate the 1949 table in terms of 1961 prices has the additional advantage of making the calculation of the inverse matrix corresponding to this table easier.

If we relate the 1949 table calculated in terms of 1961 prices with the 1949 table calculated in terms of 1949 prices we are referring to a situation where, relatively to the base year 1961, only prices have changed. This means that if the set of technical coefficients (i.e. the elements in matrix A), are calculated for a year in which only prices have changed, we get:[1]

$$A^*_{ij} = \frac{X^*_{ij}}{X^*_j} = \frac{p_i \; X_{ij}}{p_j \; X_j} = A_{ij} \frac{p_i}{p_j} \qquad (i,\ j = 1,2,\ .\ .\ .\ ,n) \qquad (4.1)$$

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[1]The following is a close outline of Rasmussen's discussion, op. cit., pp. 194-195.

where P_i, P_j are price indexes.

The diagonal matrix of price indexes could be written as

$$p = \begin{bmatrix} P_1 & 0 & \cdots\cdots & 0 \\ 0 & P_2 & \cdots\cdots & 0 \\ \cdots & \cdots & \cdots & \cdots \\ \cdots & \cdots & \cdots & \cdots \\ 0 & \cdots & \cdots & p_n \end{bmatrix} \text{ and its inverse as } p^{-1} = \begin{bmatrix} 1/P_1 & 0 & \cdots\cdots & 0 \\ 0 & 1/p_2 & \cdots & 0 \\ \cdots & \cdots & \cdots & \cdots \\ \cdots & \cdots & \cdots & \cdots \\ 0 & \cdots & \cdots & 1/p_n \end{bmatrix}$$

In matrix notations we can write

$$A^* = pAp^{-1} \qquad (4.2)$$

where

$$A^* = [A^*_{ij}]$$

If now instead of matrix A* we consider matric I - A*, equation (4.2) becomes

$$[I - A^*] = I - pAp^{-1} = p[I - A]p^{-1}$$

and $$[I - A^*]^{-1} = p[I - A]^{-1}p^{-1} \qquad (4.3)$$

or $$Z^* = pZp^{-1} \qquad (4.4)$$

where $$Z = [I - A]^{-1}$$

Thus in Rasmussen's words "the inverse matrix of a current year where only prices have changed can be calculated by premultiplying the inverse for the base year by the diagonal matrix of price indexes p and postmultiplying it by

the diagonal matrix p^{-1}."[1] It can be seen that this method is easier than the alternative of calculating $[I - A^*]^{-1}$ directly. This would have meant an additional inversion of matrix $I - A^*$ which is now avoided.

In the Canadian data used here, the 1949 matrix of technical coefficients A_{ij} is given in current (1949) prices as well as in 1961 prices. The elements of Z (i.e. referring to 1949 in 1949 prices) were calculated directly. Then the elements of Z* (i.e. referring to 1949 in 1961 prices) were calculated from an equation similar to equation (4.4), i.e.

$$Z = pZ^*p^{-1} \tag{4.5}$$

from which it follows that

$$Z^* = p^{-1}Zp \tag{4.5}$$

In terms of scalars (4.5) shows directly that

$$Z^*_{ij} = Z_{ij} \frac{P_j}{P_i} \tag{4.6}$$

In this study the data referring to Canada have been used in the form in which they appear when 1949 is presented in 1961 prices. This means that the indexes considered will have 1961 as their base year while 1949 is the "current year." In tables B-1 to B-7 of Appendix B the aggregated 1949 flow Canadian table is shown together with tables of "technical coefficients," i.e. the matrices A, and tables of the relevant inverse matrices, i.e. the matrices Z. In table B-1 the 1949 aggregated basic table is shown. Table

[1] *Ibid.*, p. 194.

B-2 is the matrix of technical coefficients A corresponding to table B-1. Its inverse matrix is shown in table B-3.

The technical coefficients of the 1961 table that have been aggregated to correspond to the matrix of the technical coefficients of the 1949 table are shown in table B-4. Table B-5 shows the inverse of table B-4. Tables B-6 and B-7 contain the matrix of the 1949 technical coefficient valued at 1961 prices and the inverse of it, respectively.

4. The 1961 Input-Output Model

Unlike the 1949 input-output model for Canada, the 1961 model has features which are not characteristic of conventional input-output tables. For example, both the inputs and outputs of industries are classified in two ways (a) according to the producing or using industry and (b) according to the commodity produced or used. Furthermore, in the new system the number of commodities is greater than the number of industries.

In this new system then, the one to one correspondence between industries and their principal products if abandoned; the principal or characteristic product of each industry is often subdivided into several commodities. Hence the table containing the outputs and intermediate inputs or industries is rectangular rather than square. This rectangular arrangement can be seen in Table 4.1.

TABLE 4.1

HYPOTHETICAL EXAMPLE OF A SET OF INPUT-OUTPUT ACCOUNTS

(For An Economy in which there are Three Industries which Produce Five Commodities)

(Billions of Dollars)

		Commodities					Industries			Final Demand & Imports							
		1	2	3	4	5	A	B	C	P	G	F.C.F.	inv	NX	RX	-M	Total
Commodities	1						3	3	1	3	1					-3	15
	2						7	4	2	10	2	4	1	10	1	-18	23
	3						2	2	1	5		4					14
	4						8	10	4	10	3					-1	34
	5						3	3	1	10	1	2		3		-1	22
Industries	A	15	22	8	1												46
	B		1	4	30												35
	C			2	3	22											27
Commodity Taxes							1	1		9	2	2					15
Indirect Taxes							2	1	1								4
Wages & Salaries							14	8	12		13						47
Surplus							6	3	5								14
Total		15	23	14	34	22	46	35	27	47	22	12	1	20	1	-23	

Where: P - Personal Expenditures on Consumer Goods and Services
G - Government Expenditures on Goods and Services
F.C.F- Business Gross Fixed Capital Formation
Δ inv - Value of the Physical Change in Inventories
NX - Net Exports of Goods and Services
RX - RE-Exports of Goods and Services
M - Imports of Goods and Services

Source: D.B.S op. cit., diagram 3, p. 36.

TABLE 4.2

	Competitive Commodities	Industries	Final Demand Less Imports	Total
Competitive Commodities		U	e	q
Industries	V			g
Primary Inputs		y'	ye	
Total	q'	g'		

Notations: Capital letters are used for matrices, small letters for vectors and scalars. Column vectors and sectors are unprimed; row vectors are primed.

U is the matrix of the values of intermediate inputs.
V is the matrix of the values of outputs.
q is the vector of the values of total commodity outputs.
g is a vector of the values of total industry outputs.
e is a vector of the values of final demand less imports for competitive commodities.
y' is a vector of the values of the primary inputs of industries.
ye is a vector representing the value of the primary inputs associated with final demand less imports.

Source: D.B.S., op. cit., diagram 12, p. 136.

The following is a brief outline of the description of such a table as given by Statistics Canada.[1] The table and an abstract of it can be seen in tables 4.1 and 4.2 of this study. In the abstract, final demand less imports of competitive commodities is shown in a single column and is represented by the letter e. Similarly the primary inputs of industries are included in a single raw y'.

Models based on the information contained in this framework involve two sets of assumptions. The first has the function of allocating the production of commodities to industries. The second establishes the production functions of industries which in turn determines the requirements of industries for commodity inputs. These assumptions, in conjunction with the accounting balance between total demand less imports and domestic production, establish input-output models in which outputs are determined as a function of final demand less imports.

The assumption concerning the allocation of commodity production among industries is that industries will preserve their share of the market for each commodity regardless of the level of commodity production. The mathematical expression of this assumption is the matrix equation

$$g = D\,q \tag{4.7}$$

where vector g represents the value of industry outputs and

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[1]Dominion Bureau of Statistics, The Input-Output Structure of the Canadian Economy, 1961, Vol. 1, pp. 135-64.

vector q the value of commodity outputs. Matrix D is a matrix of coefficients which is computed by dividing each element in a column of the output matrix V by the corresponding total commodity output. D will be called the "Market Share Matrix."

The production functions of industries can be defined by supposing that the value of the inputs of each industry are fixed proportions of the value of the total output of that industry and are independent of the composition of this output. This assumption is the familiar "industry technology" assumption which is a basic one in input-output analysis. It is expressed mathematically in the matrix equation

$$Ui = Bg \tag{4.8}$$

where U is the matrix of commodity inputs of Table 4.2.

In the D.B.S. model, "vector i is a summation vector, equal in dimension to the number of industries, whose elements are all equal to 1. The matrix product Ui is therefore a vector[1] containing the sum of the intermediate inputs of all industries classified by commodity. Matrix B is a matrix of

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[1]Assuming n conditions and m industries (n > m) the matrix product is n x n x m x 1 = n x 1 vector of commodities.

The steps in deriving (4.10) and (4.11) are as follows: substituting (4.7) into (4.9) yields $q = BDq + e$ from which $q - BDq = e$ and $q[1 - BD] = e$. Or $q = [1 - BD]^{-1}e$ which is Eq'n. (4.10). Substituting this value of q back into eq'n. (4.7) yields $g = D[I - BD)^{-1}e$ or $g = [1 - DB]^{-1}De$ which is eq'n. (4.11).

coefficients which is obtained by dividing each element in a column of matrix U by the corresponding total industry output. B is in other words the industry technology matrix. Vector g represents, as before, industry outputs. Equation (4.8) then states that total intermediate inputs classified by commodity can be calculated as the product of the industry technology matrix and the vector of industry outputs."[1] The expression of the accounting balance between commodity production and intermediate plus final demand less imports is

$$q = Bg + e \qquad (4.9)$$

Substituting equation (4.7) into equation (4.9) yields the following input-output models.

$$q = [1 - BD]^{-1}e \qquad (4.10)$$

and

$$g = [1 - DB]^{-1}De \qquad (4.11)$$

The first of the two expressions transforms final demand less imports (e), into commodity outputs, while the second transforms it into industry outputs.

Equations (4.10) can be omitted. Equations (4.11) could be solved for industry outputs and the results substituted into equation (4.9) to get commodity outputs. This second method has the advantage of avoiding the calculation of an inverse matrix for equations (4.10) which would be equal in dimension to the number of commodities that is generally greater than that of industries. By contrast, the inverse involved in equation (4.11) is smaller

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[1] D.B.S., *op. cit.*, pp. 137-38.

having a dimension equal to the number of industries. Thus commodities can be detailed without requiring the inversion of a large matrix to solve for commodity outputs.

In the 1961 model just described, imports are divided between competing and non-competing. Competing imports are treated as exogenous variables while non-competing ones are determined endogenously, either by the levels of industry outputs when they are used by industries, or are arbitrarily specified as constant proportions of final demand when they are used for final consumption.

By contrast the 1949 Canadian model treats all imports, competing and non-competing as endogenous variables.[1] Since this study includes comparisons based on the two input-output tables it is necessary to treat all imports in the 1961 tables in a similar fashion.

One way to determine the levels of competing imports is to consider such imports as a constant proportion of the total supply of each commodity.

This can be formally expressed as

$$m = \hat{\mu}(q + m) \qquad (4.12)$$

where m is a vector representing competing imports, $\hat{\mu}$ is a diagonal matrix of coefficients whose elements are the ratio of competing imports to total supply for each commodity. Vector q, as has already been defined, contains the values

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[1] Dominion Bureau of Statistics, The Interindustry Flow of Goods and Services, Canada 1949, cat. No. 13-510, 1956, p.12.

of total commodity outputs. Thus the vector sum $(q + m)$ represents the values of the total supply of commodities.

If equation (4.12) is combined with equations (4.7) and (4.9) modified so that matrix D^* replaces D in (4.7) (i.e. $g = D^*q$) and vector e^* replaces e in (4.9) (i.e. $q = Bg + e^*$) the following input-output model is obtained:

$$g = [I-D^*B]^{-1} D^*e^* \tag{4.13}$$

where $$D^* = D\,[I-\hat{\mu}]$$

and $$e^* = e + m$$

In the 1961 Statistics Canada model, matrix $D[I-\hat{\mu}]$ of expression (4.13) "is the new market share matrix for which the matrix share coefficients of industries are calculated as a proportion of the total supply of each commodity rather than as a proportion of the domestic production of each commodity."[1]

Matrix B has just been defined as the industry technology matrix, while D or D^* (when imports are included) is the market share matrix which determines the output of each industry. It follows then that the matrix product DB or D^*B is the interindustry matrix of intermediate input coefficients. From these two matrices, D^*B is the most appropriate for comparison with the 1949 $[A_{ij}]$ matrix since it is the one that treats imports endogeneously.

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[1]D.B.S. <u>The Input-Output Structure of the Canadian Economy 1961</u>, p. 141.

Matrices $\hat{\mu}$ and B are included in the Dominion Bureau of Statistics' publication where the 1961 input-output tables are given. Matrix D, however, is not for reasons of confidentiality.[1]

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[1]Data for matrix D were made available by Mr. R. B. Hoffman of the Dominion Bureau of Statistics on January 27, 1970.

TABLE 4.3

CALCULATION OF PRICE INDEXES OF CANADIAN INDUSTRIES
(1949 INPUT-OUTPUT CLASSIFICATION)

Industry	1949 Input-Output Tables Industry Numbers (1)	Index of[1] Real Domestic Product (1961=100) (2)	Weights[1] as % of 1961 Canada Real G.D.P. (3)	Value of[2] G.D.P. at Factor Cost by Industry (in Millions of 1949 $) (4)	Value of[3] G.D.P. at Factor Cost by Industry (in Millions of 1961 $) (5)	% Change in Value of Output (Columns 4:5 x 100) (6)	Price Index 1949 = 100 (Columns 2:6 x 100) (7)	Price Index 1961 = 100 (Columns 6:2 x 100) (8)
1 Agriculture	1	86.8	4.56	1,601	1,749	91.8	94.5	105.8
2 Forestry	2	69.8	1.26	316	403	78.4	89.2	112.3
3 Fishing and Trapping	3	92.8	.26	81	89	91.0	102.1	95.9
4 Metal Mining & Non-Ferrous Metals Smelting & Refining	4	48.6	3.25	455	1,107	41.1	118.4	84.6
5 Coal Mining, Guide Petroleum & Natural Gas	5	23.1	1.03	142	530	26.7	86.3	115.6
6 Non-Metal Mining Quarrying and Prospecting	6	46.6	.39	68	175.3	38.8	120.1	84.3
7 Meat Products	7	61.7	.55	77	187	41.2	149.6	66.8
8 Dairy Products	8	59.0	.53	67	183	36.6	161.1	62.0
9 Fish Processing and Miscellaneous Food Preparations	9 +16	55.0	.42	61	153	40.5	135.8	73.6
10 Fruit & Vegetable Preparations	10	50.3	.26	37	89	41.6	120.9	82.7
11 Grain Mill Products	11	67.9	.21	39	79	49.4	137.4	72.7

(Table 4.3 - Continued)

Industry	1949 Input-Output Tables Industry Numbers (1)	Index of[1] Real Domestic Product (1961=100) (2)	Weights[1] as % of 1961 Canada Real G.D.P. (3)	Value of[2] G.D.P. at Factor Cost by Industry (in Millions of 1949 $) (4)	Value of[3] G.D.P. at Factor Cost by Industry (in Millions of 1961 $) (5)	% Change in Value of Output (Columns 4:5 x 100) (6)	Price Index 1949 = 100 (Columns 2:6 x 100) (7)	Price Index 1961 = 100 (Columns 6:2 x 100) (8)
12 Bakery Products	12	68.4	.52	86	183	48.1	142.1	70.3
13 Carbonated Beverages	13	62.8	.23	29	88	33.0	190.3	52.6
14 Alcoholic Beverages	14	57.7	.59	106	201	52.7	109.4	91.3
15 Confectionary & Sugar & Refining	15	79.9	.23	49	87	56.3	141.9	70.5
16 Tobacco & Tobacco Products	17	47.1	.23	37	76	48.7	96.7	103.4
17 Rubber Products	18	67.6	.41	63	146	43.2	156	63.9
18 Leather Products	19	78.0	.29	85	107	79.5	98.1	101.9
19 Textiles (Excluding Clothing)	20	64.8	.90	239	319	74.9	86.2	115.6
20 Clothing Textile & Fur	21	73.0	1.07	290	376	77.1	94.6	105.6
21 Furniture	22	58.3	.45	72	156	46.1	126.1	79.1
22 Wood Products (Excluding Furniture)	23	66.3	1.12	245	383	64.0	103.6	96.5
23 Paper Products	24	66.3	2.68	407	937	43.5	152.4	65.6
24 Printing & Publishing & Allied Industries	25	56.2	1.36	189	469	40.3	139.4	71.7
25 Primary Iron & Steel	26	51.3	1.01	130	347	37.5	136.9	73.1
26 Agricultural Implements Iron & Steel Products n.e.c Non-Ferrous Metals Products n.e.c.	27 +28 +31	--	--	558	1,134	--	--	--

(Table 4.3 - Continued)

Industry	1949 Input-Output Tables Industry Numbers	Index of[1] Real Domestic Product (1961=100)	Weights[1] as % of 1961 Canada Real G.D.P.	Value of[2] G.D.P. at Factor Cost by Industry (in Millions of 1949 $)	Value of[3] G.D.P. at Factor Cost by Industry (in Millions of 1961 $)	% Change in Value of Output (Columns 4:5 x 100)	Price Index 1949 = 100 (Columns 2:6 x 100)	Price Index 1961 = 100 (Columns 6:2 x 100)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
27 Transportation Equipment	29	77.3	2.01	454	685	66.3	116.4	85.8
28 Jewellery & Silverware & Miscellaneous Manufacturing Industries n.e.c.	30 +36	--	--	101	295	34.2	118.9	84.1
29 Electrical Apparatus & Supplies	32	47.5	1.57	217	542	40.0	118.9	84.2
30 Non-Metallic Mineral Products	33	45.6	.89	117	305	38.3	118.9	84.2
31 Products of Petroleum & Coal	34	35.8	.58	80	248	32.3	109.8	91.1
32 Chemicals & Allied Products	35	39.1	1.68	199	606	32.8	119.6	83.6
33 Construction	37	51.9	5.84	1,090	2,688	40.6	127.8	78.2
34 Transport Storage & Trade	38	55.6	20.12	3,152	6,792	46.4	119.7	83.5
35 Communication	39	47.1	2.58	201	913	22.0	214.1	46.7
36 Electricity Water & Gas Utility	40	31.6	2.81	277	837	33.2	95.1	101.1
37 Finance Insurance & Real Estate	41	57.8	12.01	1,183	3,999	29.6	195.3	51.2
38 Service Industries	42	63.4	13.79	2,289	2,502	--	--	--

n.e.c. - Abbreviation of not elsewhere classified.

[1] Source: Indexes of Real Domestic Product by Industry (1961 Base) D.B.S. Cat. No. 61-506, Table 1, July 1968.

[2] Source: The Interindustry Flow of Goods and Services, Canada 1949 D.B.S. Cat No. 13-510, Table 1, July 1956.

[3] Source: The Input-Output Structure of the Canadian Economy 1961 D.B.S. Cat. No. 15-501, Table 8, August 1969.

CHAPTER V

INTERTEMPORAL CHANGES OF INDUSTRIAL LINKAGES IN CANADA

As time progesses, technology changes and this change is likely to change the production structure of the various industries and thus their linkage effects.

Such changes could be detected by examining two interindustry tables reflecting the ruling technology in two different periods of time.

In the case of Canada such two periods are represented by the 1949 and the 1961 input-output tables. The present study uses the aggregated form of these two tables. For purposes of comparability the tables are aggregated to a size of 38 by 38.

Table 5.1 shows the aggregations made. The indexes used to measure the linkage effects of an industry for each of the two periods are similar to those employed for the inter-country study. A comparison of the corresponding indexes will then show the magnitude of the change.

1. Changes in Linkage Effects over Time

Considering the u_j and w_i indexes first, the 38 sectors are classified in a way similar to that of Chapter III. Table 5.2 shows the values of the u_j, w_i indexes for the years 1961 and 1949 calculated in terms of 1961 prices. In Tables 5.3 and 5.4, the sectors are classified on the basis of these two indexes for the two time periods.

As was the case in Chapter II the demarcation lines for classifying sectors into the four categories, are the average values of u_j and w_i for each of the two years. The terms "final", "Intermediate" and "primary" have the same meaning as those in Chapter III. That is, sectors described as final, have low w_i values, those described as "primary" have low u_j values etc.

The concepts of "indirect use" and "Indirect demand" are more comparable here where two different time periods are examined, than was the case with the international comparison. The reason is that the three sources of variations mentioned in Chapter III are reduced or eliminated completely. For example, there is no difference in the treatment of investment between the two periods. The establishment remains the basic accounting unit in the two periods and finally there are no changes such as transfers of secondary products to the sector of primary production. On the other hand there are cases where certain operations were considered an integral part of an industry in 1949 while they are recorded as separate industries in 1961. In the first case flows from one operation to another within the same industry are netted out, while in the second they would show as inputs to the separate industry and so would be recorded in the input-output transactions and thus alter the values of u_j and w_i. Such is the case for example, with sector No. 4 (metal mining and non-ferrous metals smelting and refining). In 1949, the smelting and refining of certain companies were considered an integral part of the

TABLE 5.1

INDUSTRY CLASSIFICATION

	Aggregated Industries (1)	Corresponding 1949 Industries (2)	Corresponding 1961 Industries (3)	Standard Industrial[1] Classification 1948 Manual (4)	Standard Industrial[2] Classification 1960 Manual (5)
1	Agriculture	1	1	00-079	001,003,006, 011,013,015, 017,019,021, 031,039
2	Forestry	2	2	080-089	031,039
3	Fishing, Hunting & Trapping	3	3	091-097	041,045,047
4	Metal Mining and Non-Ferrous Metal Smelting and Refining	4	4+32	101-119,345	051-059,295
5	Coal Mining, Crude Petroleum & Natural Gas[3]	5	6+7	121-126	061-066
6	Non-Metal Mining, Quarring and Prospecting	6	5	131-133, 139-179	071,073,077 079,083,087
7	Meat Products	7	8	200	101-103
8	Dairy Products	8	9	201-209	105-107
9	Fish Processing	9+16	14	210,228	111,135,139
10	Fruit and Vegetable Preparations	10	10	212	112
11	Grain Mill Products	11	11	213-216	123,124,125
12	Bakery Products	12	12	218-219	128,129

(Continued)

(Table 5.1 Continued)

	Aggregated Industries (1)	Corresponding 1949 Industries (2)	Corresponding 1961 Industries (3)	Standard Industrial[1] Classification 1948 Manual (4)	Standard Industrial[2] Classification 1960 Manual (5)
13	Carbonated Beverages	13	15	22	141
14	Alcoholic Beverages	14	16	221-224	143,145,147
15	Confectionary and Sugar Refining	15	13	225-227	131,133
16	Tobacco and Tobacco Products	17	17	230	151-153
17	Rubber Products	18	18	236,239	161,164,169
18	Leather Products	19	19	241-249	172,174,175, 179
19	Textile Products (Excluding Clothing)	20	20+21+24	251-269	183,193,197, 201,211-229
20	Clothing (Textile & Fur)	21	22+23	270-279	231,239,242-249
21	Furniture	22	26	286	261,264,266, 268
22	Wood Products Excluding Furniture	23	25+27	281-285	251,252,254 256,258,259
23	Paper Products	24	28+29	292-299	271-274
24	Printing and Publishing and Allied Industries	25	30	201-309	286-289
25	Primary Iron and Steel	26	31	325	291

(Continued)

(Table 5.1 Continued)

	Aggregated Industries (1)	Corresponding 1949 Industries (2)	Corresponding 1961 Industries (3)	Standard Industrial[1] Classification 1948 Manual (4)	Standard Industrial[2] Classification 1960 Manual (5)
26	Agricultural Implements - Iron & Steel Products n.e.c. - Non-Ferrous Metal Products n.e.c.	27+28+31	33+34+35+ 36+37	311-324,326- 341,342,347 349	301-309,311, 315-318,292, 294,296-298
27	Transportation Equipment	29	38+39+40+ 41	330-339	321,323,324, 325,326,327, 328,329
28	Jewellery and Silverware - Miscellaneous Manufacturing Industries	30+36	53	343,346	381-385,393, 397,399
29	Electrical Apparatus and Supplies	32	42+43+44+ 45	351-359	331-339
30	Non-Metallic Mineral Products	33	46+47	137,361- 369	341-359
31	Products of Petroleum and Coal	34	48	373-379	365,369
32	Chemicals and Allied Products	35	49+50+ 51+52	380-389	371-379
33	Construction	37	54	404-439	404-421
34	Transportation Storage and Trade	38	55+56	501-527, 701-799	501-527, 602-699
35	Communication	39	57	543-549 914	543-548

(Continued)

(Table 5.1 Continued)

Aggregated Industries (1)	Corresponding 1949 Industries (2)	Corresponding 1961 Industries (3)	Standard Industrial Classification 1948 Manual[1] (4)	Standard Industrial Classification 1960 Manual[2] (5)
36 Electricity, Water and Gas Utilities	40	58	602-609	572-579
37 Finance Insurance and Real Estate	41	59	802-809	702-737
38 Service Industries	42	60+61+62+ 63+64+65	901-911, 916-949	801-991

[1] Dominion Bureau of Statistics, Standard Industrial Classification Manual, 1951 Census Edition (Ottawa: The Queen's Printer, 1951).

[2] Dominion Bureau of Statistics, Standard Industrial Classification Manual, (Ottawa: The Queen's Printer, 1960).

[3] Services incidental to Mining such as prospecting, drilling, etc., are included in sector 5 (coal mining, crude petroleum and natural gas) according to the 1961 industrial classification list. They are grouped with sectors 6 (non-metal mining, quarrying and prospecting) in the 1948 classification. The weight of these services, however, computed as a percentage of Canadian G.D.P., is sufficiently small (0.05%) so as not to seriously affect the comparability of either sector between the two years examined. The computation of weights is based on data from the "Indexes of Real Domestic Product by Industry of Origin 1935 - 61" of the Dominion Bureau of Statistics (p. 68.)

TABLE 5.2

RATIOS OF INTERINDUSTRY USE

Industry	Ratio to Production u_j 1949	1961	Ratio to Total Demand w_i 1949	1961
1	42.7	36.6	47.5	65.7
2	20.1	46.3	94.0	89.9
3	20.8	25.8	52.5	71.2
4	22.4	47	13.4	45.0
5	19.3	37.0	74.9	60.6
6	25.8	30.3	49.3	41.3
7	59.7	76.7	13.8	26.8
8	52.0	71.4	6.0	20.4
9	52.0	71.4	6.0	33.9
10	69.7	61.3	5.4	20.0
11	72.3	77.8	58.5	69.1
12	56.3	54.1	1.6	12.9
13	40.1	43.9	7.4	22.8
14	43.3	47.7	3.5	11.3
15	27.8	39.1	24.7	33.1
16	77.9	70.8	24.0	22.0
17	30.2	41.2	45.4	65.8
18	53.2	55.1	24.0	22.1
19	38.0	44.3	70.1	71.3
20	43.2	48.9	4.2	11.9
21	38.8	46.8	23.6	13.2
22	55.8	60.2	63.1	58.7
23	40.9	52.1	39.4	44.8
24	42.6	41.2	77.2	65.9
25	35.9	46.9	83.8	85.5
26	33.8	49.0	58.1	62.3
27	41.6	47.7	33.0	30.2
28	34.0	44.9	37.3	37.3
29	38.7	45.2	47.2	43.9
30	36.5	47.2	74.4	81.7
31	34.2	52.8	79.1	58.3
32	44.3	49.6	53.1	60.6
33	56.9	47.7	27.3	15.4
34	28.7	32.2	44.1	37.1
35	23.4	20.9	61.8	56.6
36	42.1	31.2	68.1	60.9
37	24.4	21.4	35.6	26.8
38	24.0	56.6	14.3	64.1

Source: Data in this table are calculated on the basis of the aggregated 1949 and 1961 input-output tables for Canada.

TABLE 5.3

TYPES OF INDUSTRIES 1949

	Final $w_i < 41$				Intermediate $w_i > 41$			
	III	Final Manufacture	u_j	w_i	II	Intermediate Manufacture	u_j	w_i
Manufacturing $u_j > 40$	7	Meat Products	60	14	1	Agriculture	43	48
	8	Dairy Products	52	6	11	Grain Mill Products	72	59
	9	Fish Processing	45	17	22	Wood Products	56	63
	10	Fruit & Vegetable			24	Printing & Publishing	43	77
		Preparation	70	6	32	Chemicals	44	53
	12	Bakery Products	56	2	36	Electricity, Water, Gas	42	68
	14	Alcoholic Beverages	43	4				
	16	Tobacco and Products	78	24				
	18	Leather Products	53	24				
	20	Clothing	43	4				
	23	Paper Products	41	39				
	27	Transportation						
		Equipment	42	33				
	33	Construction	57	27				
	I	Final Primary Production	u_j	w_i	1	Intermediate Primary Production	u_j	w_i
Primary Production $u_j < 40$	4	Metal Mining	22	13	2	Forestry	20	94
	13	Carbonated Beverages	40	8	3	Fishing, Hunting & Trapping	21	53
	15	Confectionary & Sugar			5	Coal Mining, Petroleum &		
		Refining	28	25		Natural Gas	19	75
	21	Furniture	39	24	6	Non-Metal Mining	26	49
	28	Miscellaneous Manufac-			17	Rubber Products	30	46
		turing Industries	34	37	19	Textile Products	38	70
	37	Finance & Insurance	25	36	25	Primary Iron & Steel	36	84
	38	Service Industries	24	14	26	Agricultural Implements	34	58
					29	Electrical Apparatus &		
						Supplies	39	47
					30	Non-Metallic Mineral		
						Products	37	74
					31	Products of Petroleum &		
						Coal	34	71
					34	Transportation Storage &		
						Trade	34	79
					35	Communication	29	44

Note: The values of u_j and w_i are from Table 5.2.
The average values for the two indexes for each group are:
Group 1 $u_j = 37$, $w_i = 64.9$; Group II $u_j = 50$, $w_i = 61.3$,
" III $u_j = 53$, $w_i = 16.7$; " IV $u_j = 30.3$, $w_i = 22.4$

TABLE 5.4

TYPES OF INDUSTRIES 1961

	Final W_i < 45			Intermediate w_i > 45		
Manufacturing $u_j > 47$	III Final Manufacture	u_j	w_i	II Intermediate Manufacture	u_j	w_i
	7 Meat Products			11 Grain Mill Products	78	69
	8 Dairy Products			22 Wood Products	60	59
	9 Fish Products			26 Agricultural Implements	49	62
	10 Fruit & Vegetable Prep.			31 Products of Petroleum and Coal	53	58
	12 Bakery Products			32 Chemicals	50	61
	14 Alcoholic Beverages			38 Service Industries	57	64
	16 Tobacco and Products					
	18 Leather Products					
	20 Clothing					
	23 Paper Products					
	27 Transportation Equip.					
	33 Construction					
Primary Production $u_j < 47$	IV Final Primary Production	u_j	w_i	1 Intermediate Primary Production	u_j	w_i
	4 Metal Mining	47	47	1 Agriculture	37	66
	6 Non-Metal Mining	30	41	2 Forestry	46	90
	13 Carbonated Beverages	44	23	3 Fishing, Hunting & Trapping	26	71
	15 Confectionery & Sugar Refining	39	33	5 Coal Mining, Petroleum & Natural Gas	37	61
	21 Furniture	47	13	17 Rubber Products	41	66
	28 Miscellaneous Manufacturing Industries	45	37	19 Textile Products	44	71
	29 Electrical Apparatus & Supplies	45	43	24 Printing & Publishing	41	66
	27 Finance, Insurance & Real Estate	22	27	25 Primary Iron & Steel	47	86
				30 Non-Metallic Mineral Products	47	82
				34 Transportation, Storage & Trade	21	57
				35 Communication	21	57
				36 Electricity, Water & Gas	31	61

Note: The values of u_j and w_i are from Table 5.2.

Group 1 $u_j = 30.5$, $w_i = 65.2$; Group II $u_j = 57.8$, $w_i = 62.2$;

" III $u_j = 58.0$, $w_i = 22.7$; @ IV $u_j = 39.9$, $w_i = 32.8$.

mining operation. Thus flows of ores from the mines to the smelter were netted out. On the other hand, in 1961, smelting and refining was defined to be a separate manufacturing industry and flows of ore would in this case be shown as inputs to that industry and hence the values of u_j and w_i would be higher in 1961. This can be better seen if we consider the case of two sub-industries which are parts of one larger industry. When flows from one sub-industry to the other are recorded, the a_{ii} coefficient that indicates the inputs purchased by an industry from itself has, let us say, a given known value. When such record of intrasector transactions is deleted or lost, as was the case when smelting and refining was part of the metal mining industry, the a_{ii} coefficient decreases because its value no longer contains the value of the deleted intrasector transaction. We recall that the numerator U_j of the u_j index is equal to $\sum_i X_{ij}$, where $\sum_i X_{ij} = \sum_i a_{ij} X_j$ and $\sum_i a_{ij}$ includes the diagonal coefficient a_{ii} (or a_{jj}) which is now smaller because the intrasector transaction is not recorded. Hence $\sum a_{ij}$ is also smaller and so is $\sum_i a_{ij} X_j$ which by definition is equal to U_j (i.e. $\sum_i a_{ij} X_j = U_j$). Since the total output X_j of the larger industry is the same as before, it means that the ratio $\frac{U_j}{X_j} = u_j$ has decreased.[1]

[1] Since the U_j decreases while X_j remains the same and since by definition $X_j = U_j + VA_j$ (i.e. total output of industry j equals to the sum of intermediate inputs U_j plus the value added VA_j in that industry), it follows that VA_j increases whenever U_j decreases, i.e. whenever intrasector information is not recorded. The output X_j refers either

The opposite will happen if intraindustry transcations will be recorded in a case where previously were omitted. In this case the value of the u_j index will increase. Similar reasoning shows that the value of the w_i index will decrease when intraindustry information is lost or increase when such information is recorded.

In cases such as these, an increase in the value of the u_j w_i indexes does not mean an improvement in the linkage strength of an industry. One must be cautious, therefore, when interpreting the results of a comparison of tables not to attribute index changes to changes in technology, while in fact, these changes are due to changes in accounting methods.

Looking at tables 5.3 and 5.4 we see that in general a similar classification is reached in each of the two years. When we examine the individual industries, however, we note a number of exceptions. Industry 1 (agriculture)[1] for example, has dropped from the "Intermediate Manufacture" category to that of "Intermediate Primary Production." It has, in other words, experienced a decrease in its u_j index. There is more than one reason for such a drop.

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to the sum of the outputs of the two sub-sectors of the larger sector or to the output of that larger sector without distinguishing how much comes from one-subsector and which from the other.

[1]The numbering of industries correspond to that of Table 5.1.

One of the causes for the decline in the u_j index of the agricultural industry is, for example, the decrease in the agricultural input from industry 11 (grain mill products).[1] It is however difficult to give a reason for the decrease without adequate data on the components of industry 11. This industry includes in its definition such sub-industries as "animal feed," which again is a group consisting of "stock and poultry feed," "flour mills," "prepared breakfast foods," etc.

One must know which of these components has been replaced by other products as inputs to the agricultural industry in order to determine which of the a_{ij} coefficients caused the change in the u_j index.

The agricultural industry also seems to have increased its own transportation and storage activities due perhaps to an increase in the size of the agricultural production unit. This again caused a decrease in its input coefficient from the "transportation and storage" industry and in turn in its u_j index. The increase in its own transportation activity will be recorded in the value added section of the agricultural industry's column and thus will not cancel the decrease in the u_j index.

A second reversal that is apparent in 1961 is that of the "service" industry (industry 38) which has moved up to

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[1] The changes in inputs can be seen by comparing the 38 industry input-output tables B.7 and B.8 of Appendix B.

group II (Intermediate Manufacturing) because of an increase in both its u_j and w_i indexes. The change in value of both indexes is considerable as one can see either by comparing the values of the two indexes for the group in which they are included. In 1949 for example, the average u_j value for group IV where the "service" industry fell was 30.3, with services having a u_j value of 24. In 1961 the u_j average of group II was 57.9 with the service industry having a 57 u_j value. Similarly for the w_i index; in 1949 the service industry had a w_i value of 14 while the average of the group (group IV) was 22.4. In 1961, this same industry exceeded the average w_i value for group II, which was 62.2, and showed a w_i index value of 64.[1]

This strengthening of the linkage effects, both backward and forward, of the service industry is an indication of the important role that this industry plays today.

By looking at the 38 industry aggregated tables B.7 and B.8 of Appendix B one can see how this industry has increased its demand from such industries as "transportation and trade" (industry 34) for example, or from its own industry (industry 38). This suggests the important influence that the "service" industry may have on these two industries. An increase in services requires more transportation facilities and more services of a different type. One also cannot fail

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[1] The u_j, w_i averages for each group are simple averages of the values of the two indexes in the respective groups.

to notice the increase in demand for "services" from other industries such as "forestry," the "chemical industry" and the "mining industry" in general. The provision of services may not be possible without inputs from other types of services.

It is tempting to conclude from these findings on the "service" industries that the more the Canadian economy expands the more dependent it becomes on the "service" industry. It is also tempting to consider the "service" industry as an industry very useful for attracting new industries and therefore, in this sense, to be a "key industry" with regard to development. If one also remembers that the "service" industry is labor intensive one can clearly see its implications for the employment problem.

A third reversal that is apparent from Tables 5.3 and 5.4 is that of industry 6 (non-metal mining) which moved from group 1 to group IV giving the impression that it has lost strength in its forward w_i linkage. This is not so however as can be seen by a more careful comparison of the 1961 w_i value for that industry with the value of the same index in 1949. Such a comparison shows that the w_i index has gone up in 1961 showing an increase in the "forward" linkage of sector 6 rather than a decline. The increase in the forward linkage of that sector can also be seen by comparing its w_i value with the average w_i value for group

IV where the industry is classified in 1961.[1] It is only when one compares the w_i value of industry 6 to the average w_i value for the whole economy in 1961 one sees that this industry has improved less, in terms of forward linkage, than the average improvement of the economy. This shows that although Canada has been increasing the further processing of the products of the "non-mental mining" industry, it still continues to channel a large proportion of the unprocessed product towards final demand probably towards the export component of final demand.

A fourth reversal occurs in the case of sector 29 (electric apparatus and equipment). This industry shows a decline in its w_i index value in 1961 and is moved to group IV from group I where it was classified in 1949.

A comparison of Tables B.7 and B.8 of Appendix B shows that although "Total Intermediate Demand" has increased in 1961, compared to 1949, it has not increased in proportion to "Total Demand." This means that an increased portion of this industry's products has been absorbed by "Final Consumption" and that the Canadian industrial system has not increased its inputs from that industry.

"Printing and publishing" industry (industry 24) was also reclassified in 1961 to group 1 from group II due

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[1] The average w_i value for group IV for 1961 is $w_i = 33$ while the average w_i value for the whole economy for 1961 is $w_i = 45$ as can be seen from Table 5.4.

to a decrease in the value of its u_j index. This decrease seems to come mainly from a decrease of the input from the "paper and products" industry due perhaps to a more efficient utilization of inputs. Another major cause for such a decrease in the u_j value is the decrease in the input coefficient from the "finance and insurance" sector indicating perhaps an increase in self-financing in the "printing and publishing" industry.

Industry 26 (agricultural implements) shows an increase in its u_j value and as the B.7 and B.8 input-output tables indicate this increase comes mainly from industries 4 (non-metal mining smelting and refining) and industry 25 (primary iron and steel). The agricultural implements are likely to have undergone more than ordinary changes during the period 1949-1961 and the type of equipment used in 1961 seems to use a lot more metallic parts including iron and steel. We must be careful here not to lean too heavily on this explanation because of aggregation in this sector.

The "products of petroleum and coal" industry (industry 31) is another industry whose u_j index shows an increase. This increase is mainly due to a substantial increase in the input coefficient from industry 5 (coal mining, petroleum and natural gas). It happens that industry 5 includes in its classification the activities of "prospecting" and "drilling." Since these activities have been increasing in Canada in the recent years they seem to be mainly responsible for the increase in the coefficient in

question. In other words the increase of the input coefficient of sector 31 from sector 5 is not so much due to an increase in the consumption of coal and crude petroleum by sector 31 but rather due to an increase in the consumption of such services as prospecting and drilling.

Industry 31 shows also a decrease in its w_i index in the later year due perhaps to a greater relative increase in final consumption as compared to the intermediate demand for its products.

Finally the industry "electricity water and gas utilities" (industry 36) shows a decline in its u_j index. This is due to a decrease in several input coefficients. A major decrease occurs in the input from sector 31 (products of petroleum and coal). This could be due to an increase in the use of hydropower and natural gas for power generation, heating and other purposes, at the expense of coal and oil uses which dominated earlier periods. A second major decrease in a coefficient occurs in the input coefficient from the "chemicals and allied products" sector. The reason for such a decrease could be mainly because of a decrease in the use of acetylene and synthetic gas for lighting and heating purposes in the earlier period.

In general, the decline of the u_j value of the "utilities" industry (36), is the result of decreases of several of the input coefficients of that industry and a strong reason for such decreases is mainly that of changing technology (more electric than fuel run motors).

The cases just discussed are the most extreme ones where the change in the two indexes was large enough to reclassify an industry from one group (of tables 5.3 and 5.4) to another.

Less extreme changes, but prominent enough nevertheless, occur in some other industries within each group. Taking simple differences between the 1949 and 1961 u_j and w_i values in each group, we can see which industries show a relatively greater improvement and which are the ones that show a relatively greater deterioration.

On this basis and excepting the reclassification cases already analyzed, we see that in group 1 for instance, industries 2 and 5 show a most noticeable increase in their u_j values (a difference of +26 and +18 respectively). Industries 17, 25 and 30 also show a comparatively high improvement in their u_j indexes (+11, +11 and +10 respectively).

When we look at each of these industries more closely we see that in the case of sector 2 (forestry) for example, the most obvious reason for the increase in its u_j index is the increase in its input coefficient from the "services" industry (industry 38).[1] Of this industry (38), the sub-industries that are most likely to have increased their services to the forestry industry are those of "research" and "engineering services" such as endomological research,

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[1] See Tables B.7 and B.8 in Appendix B.

e.g., aerial survey, reforestation, etc.[1]

In the case of sector 5 (coal mining, petroleum and natural gas) the increase in its u_j index is the result of increases in mainly two of its input coefficients, the input coefficient from itself (i.e. from industry 5) and the input coefficient from the "financial insurance and real estate." The increase of inputs from within the industry could perhaps be explained by the increase in the use of exploration and drilling services that are included in this industry. Industry 5 seems to have also increased its dependency on outside financing for its operations.

The cases of these two industries (2 and 5) are important examples of the increasing dependency of the Canadian economy on services, whether these services are of the engineering or research type or whether they are of financial nature.

Of the other industries in group 1 that show a noticeable improvement in their u_j indexes, industry 17 (rubber products) has increased its input from the "chemicals and allied products" industry (32) strongly indicating a change in raw materials inputs from natural to synthetic rubber for its finished products. Industry 25 (primary iron and steel) shows a most prominent increase in the input coefficient from industry 4 (metal mining). This increase

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[1] See "Standard Industrial Classification Manual, 1960, *op. cit.*, p. 169.

is most likely due to the change in the type of steel products required for intermediate as well as final uses. Changes that require a higher use of other metals, e.g. such as nickel, titanium, vanadium, etc. in the production of such specialized steel varieties as those use in automotive, aviation or space craft industries. The mining activities for such metals are grouped in sector 4 which explains its increasing linkage with the "primary iron and steel" industry.

The last sector showing a relatively high increase in its u_j index in group 1 is the "non-metallic mineral products" industry (industry 30). This industry shows a most substantial increase in its input coefficient from the "service industries" industry (industry 38). The reason is not hard to visualize. Industry 30 includes such sub-industries as "cement manufacturing," "concrete products Manufacturing" "clay products manufacturing" such as china or electric insulators among other things. The products of these sub-industries are the kind of products whose quality changes fairly rapidly and this can only be done with the help of such services as engineering and research which are part of the "service industries."

The two industries in group 1 which show a decline in their u_j indexes and which are not already examined are those of "transportation storage and trade" and "communications" (industries 34 and 35 respectively).

The reasons for these declines of the u_j indexes are hard to pinpoint as there are decreases in several input coefficients some of which decreases are small enough and could very well be due to computational or aggregation errors. This is particularly the case with the input coefficient of the communication sector.

In the case of sector 34 (transportation, storage and trade) we observe some more noticeable decreases in input coefficients. There is a decrease, for example, in the input coefficient from the "finance" sector (37) indicating perhaps that financing of the transportation industry is increasingly coming from internal funds (retained earnings, for example) rather than from financial institutions. Another decrease in coefficient occurs in that from industry 33 (construction). Here one can only speculate that there may be a shift in weight of the sub-industries within industry 34. If transportation activity has increased by more than storage for example, then construction of storage facilities will be increasing by less than the rate of increase in the output of the aggregated industry (i.e. of industry 34) which would explain the decrease in the coefficient from the construction industry. An interesting switch occurs in the size of two coefficients from industries 5 (coal mining, crude petroleum and natural gas) and industry 31 (products of petroleum and coal). The first coefficient has decreased in 1961 while that from sector 31 has increased. This switch clearly indicates a change in technology in the transportation industry which now uses the more refined type

of fuels instead of raw coal and crude petroleum.

Looking now at those industries in group 1 that show the greater relative changes in their w_i index we see that those in which the index has improved the most are industries 3 (fishing, hunting and trapping) and 17 (rubber products) followed at some distance by industry 35 (communication).[1]

With respect to industry 3, the increase in its index does not seem to come from any particular single source although a reasonable explanation could be that the fishing produce is now undergoing more processing by other Canadian industries. This explanation however is not supported by the changes in coefficients observed in Tables B.7 and B.8 of Appendix B.

Industry 17 is increasing its sales to such industries as "leather products," "furniture" or "services" while it seems to have decreased its sales to the "transportation equipment" industry, probably because of competition from the chemical industry for tires and other accessories. The increases in sales of the rubber products could in many cases be due to changes in tastes rather than changes in technology. In the furniture industry, for example, the substitution of rubber products for other materials could be easily caused by such changes in tastes. A rubber foam cushion replacing a

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[1]Industry 3 shows an increase in its w_i index of 18 units. Industry 17 experiences an increase of 20 units while the w_i index of industry 35 increases by 13 units.

cotton or wool filled one can more easily be seen as caused by a change in taste rather than a technological change.

The increase in the index value of industry 35 indicates a fairly general increase in communication services by all industries.

Industries 3 (coal mining, crude petroleum and natural gas) and 34 (transportation, storage and trade) show the greatest relative decreases in their w_i index.

In the case of industry 5, this is to be expected since, as has already been pointed out, more refined fuels are now used by many industries and these refined fuels are the products of industries other than 5. Hence the decrease in the input coefficient of those industries from industry 5.

The decrease in the w_i index of the transportation industry (34) is due to the fact that more industries are using their own means of transport. This being the case, such transportation services are classified as value added in the industry in which it occurs rather than as a product of the transport industry. Thus it can be seen from Tables B.7 and B.8 that a decrease of purchases from the transport industry occurs in such sectors as "construction" (33), "electrical apparatus" (29), "meat" (7), "grain mill products" (11), etc.

If we now look at the industries in group II that have not already been examined we see that all but one show an improvement in their u_j index. The exception is the "wood products" industry which shows a deterioration in its w_i index.

Industry 11 (grain mill products) shows the larger relative increases in both u_j and w_i indexes. The increase in the u_j index comes about because of increases in mainly two input coefficients. That from the "agricultural" industry (sector 1) and that from the "fish processing" industry. The increase of inputs from the agricultural industry is caused most probably by an increase in inputs of more specialized products such as those destined for breakfast cereals or animal and poultry feeds in addition to the traditional inputs used by the "bakery products" industry. The increase in inputs from the "fish processing" industry is probably due to an increasing production in animal foods such as cat foods or poultry feeds having as ingredients ground oyster shells or fish flour.[1]

The w_i index of sector 11 experiences an increase mainly because of increased sales to industries producing specialized products such as feeds and cereal foods other than bakery products. Since most of these industries are grouped in sector 11, the largest increase in input coefficient is that from sector 11 to itself (i.e. in the a_{ii} coefficient).

Industry 32 (chemicals) also shows improvements in both indexes. The reasons are not hard to find. The increase

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[1] See classification of "grain mills" in "Standard Industrial Classification Manual, 1960", op. cit. p. 67

in u_j comes from increases in inputs from industries such as coal, crude petroleum and natural gas, or from the chemical industry itself for the production of more refined products (production of plastics, for example, from resins also produced by the chemical industry). The most spectacular increase in inputs to the chemical industry, however, comes from the "services" industry. The reason is that the chemical industry is one of the most research oriented industries in the industrial system. It is very likely, therefore, that this industry in addition to conducting its own basic research has a large research input from either private or governmental research establishments. The increase in w_i is also easy to explain. More and more industries in the industrial system use one or the other of the large variety of chemical products existing in the market. This is easily seen by comparing row 32 in Tables B.7 and B.8 of Appendix B.

The main reason for the increase in u_j in the "wood products" industry (sector 22) is increases in inputs from the "forestry" industry as well as the "wood products" industry itself. This industry experiences a drop in its w_i index. Since there is no apparent decrease in purchases from that industry by other industries it must be concluded either that there is an increase in exports for the products of that industry or that the industry is producing more of the products used by domestic final demand. A more detailed breakdown of the components of that industry would help

answer such questions.

Proceeding now with the examination of industries in group III we note that the industries showing the largest relative improvement in their u_j index are industries 7 (meat products), 8 (dairy products) and 9 (fish processing). These industries are also showing the highest relative improvements in their w_i index. The increases in their u_j index indicate an increase in dependency of these industries with such industries as "agriculture" and "paper products" and from sub-industries within their own group.

Even the "fish processing" industry shows increased purchases from agriculture. Fish canning requires vegetable oils and the more this sub-industry expands the more the purchases of such agricultural products. The increased purchases from the "paper product" industry is not hard to understand when one realizes the increased amount of packaging used by all three industries. Finally increased inter-connection between the sub-industries within each of these three industries could be due to either or both of the following reasons. Changes in tastes may require more finishing of these products such as removal of bones from meat or fish, or increase in the types of milk for sale. These finishing activities could be undertaken by various sub-sectors within the same sector because the original sub-sector was not equipped to handle them, for example. But even if the original sub-industry were equipped to handle them, an increase in production of the products of such

sub-industries may require more specialized activities which are then delegated to other sub-industries and this could be the second reason.

The increase in the w_i indexes of the products of industries 7, 8 and 9 can again be traced either in changes in tastes for the products of user industries (more milk used in bakery products) or increased specialization (more products of the fish processing industry are heading for the grain mill industry for further processing).

Of those industries that show a decline in their u_j index, over the time period under examination, industries 10 (fruit and vegetable preparation), 16 (tobacco and products) and 33 (construction) show relatively greater decreases. Of the three, the last industry (industry 33) shows also a relatively higher decline in its w_i index.

It is hard to identify the reason for the decline in u_j of industry 10. It is very likely, however, to be the result of changes in taste for the products of that industry. Fruit preparation, e.g., may use less sugar than before as the decrease in purchases from the sugar refining industry (industry 15) suggests. The same applies to the tobacco refining, with the only apparent reason for such a decline in u_j being the decrease in inputs from the "transportation storage and trade" industry.

The decrease in its w_i index is more difficult to explain. At first one might be tempted to justify it on the grounds that a greater amount of construction is being

undertaken by the purchasing industries themselves and therefore the amount of inputs of these industries from the construction industry is now reduced. This explanation however is not justified since according to the 1961 classification of industries, construction activities undertaken by the non-construction industries are included in the construction industry as this industry is defined in the 1961 input-output table.[1]

We must, therefore, look for other reasons for such a decrease in the w_i index of the construction industry. One such reason could be a greater degree of efficiency per unit of construction. In other words, a smaller constructed area is now needed to house the same activity as compared to 1949. This could be because of better design of such an area. One could think of a modern kitchen for example, as compared to one built twenty years ago; or in cases of industrial construction, one could note the reduction in the size of blast furnaces or the almost complete elimination of smoke stacks in a modern iron and steel works. The iron and steel industry in fact, shows a reduction of inputs from the construction sector.[2] Having observed the reductions in the "backward" u_j and "forward" w_i indexes of the construction industry, one must not forget that the u_j decrease is not sufficient to reclassify this industry to another group.

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[1] See "The Input-Output Structure of the Canadian Economy 1961," op. cit., pp. 122-23.

[2] See Tables B.7 and B.8 of Appendix B, this study.

This is not likely to happen in the future either. Construction activities, unlike the activities of other industries, shift from one location to another as soon as one contract is terminated and another begins. This fact makes the construction industry to depend fairly heavily on service inputs from the "transportation and storage" industry. Furthermore, it seems unlikely that the construction industry will keep increasing the proportion of its own transportation activity by much more than it already has. To do so would mean an unnecessary increase in its fixed cost of operation since in slack periods the industry would be left with a stock of equipment for which it has to incurr the costs of maintenance and storage, not to mention interest payments on loans made to purchase this equipment. The total of these costs could very well exceed any benefits that may arise from having such equipment available at short notice.

This kind of reasoning makes the construction industry an industry whose expansion requires the establishment or expansion of at least another industry, (namely that of transportation and storage), and would, therefore, make it an industry useful for further development.

Moving now to the last group of industries in tables 5.3 and 5.4, that is to group IV, we observe that the sector that shows the greatest relative increase in both u_j and w_i indexes is industry 4 (metal mining, smelting and refining).

The reason for such an increase in these indexes has

already been given above.[1] It may be added, however, that not all changes are due to the aggregation problem and some could be caused, as in other industries, by changes in technology. Because of the special aggregation problem, however, encountered in this industry it is very hard to say which cause is the most responsible for the change of the indexes.

Another industry in this group that shows a greater relative change of its indexes, although in the opposite direction, is "finance, insurance and real estate" (industry 37). The change in its u_j index is relatively small and could have easily been caused by a computational error. The change in the w_i index is fairly prominent, however, and could be explained perhaps by the fact that industries which used to borrow from financial institutions now get their funds internally from retained earnings. It must be noted,however, that members of the same industry (i.e. of industry 37) are also the sub-industries of "insurance" and "real estate." This makes it difficult to decide which of the sub-industries is more responsible for the changes. Until a finer breakdown of the input-output tables is undertaken, results of table comparisons will always lack the precision necessary for a clear and unambiguous conclusion.

In order to examine and compare the pattern of interdependence in production in each of the two years the two

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[1] See pp. 107-08 of this study.

38 by 38 input-output matrices are triangularized.[1] A comparison of the two triangular matrices (tables 5.5 and 5.6) shows a very similar order of industries for the two years. The spearman rank correlation coefficient is .75 and is significant at the 5% level.

The similarity in industry ordering can be better seen in table 5.7. In the left hand side of the table, industries are ordered in compromise ranking while in the right hand side the ranking of industries is tabulated as it exists in the two years examined. The compromise ranking is simply an ordering of industries based on the averages of the two positions that each industry occupies in each of the years. For example the "bakery products" industry is ranked first in the 1949 triangular table but it is ranked third in the 1961 one. Its average for the two years is, therefore, a value of 2. This value is smaller than the value found for the following industry "carbonated beverages" which in turn, on the basis of the same criterion, has a higher compromise ranking than the "fruit and vegetables preparations" industry and is therefore placed before it in table 5.6. The same method is followed for all 38 industries examined.

Following the methods used in Chapter III, we proceed now to examine industrial characteristics by using the more

[1] The method is the same as the one followed in Chapter III.

TABLE 5.5

1949 INPUT-OUTPUT TABLE
ARRANGED IN A QUASI TRIANGULAR MATRIX
(Adjusted for 1961 Prices)
Millions of Dollars

Producing Industry	Using Industry 12	14	20	10	8	13
12	0.0	0.0	0.0	0.0	0.0	0.0
14	0.0	6.134	0.0	0.548	0.0	0.0
20	0.0	0.0	14.867	0.0	0.0	0.0
10	1.572	0.121	0.0	4.474	0.121	0.0
8	5.806	0.0	0.0	0.968	18.710	0.0
13	0.0	0.0	0.0	0.0	0.0	10.266
4	0.0	0.0	0.0	0.0	0.0	0.0
7	21.557	0.0	0.0	6.737	0.299	0.0
38	9.626	10.339	7.665	5.704	2.743	6.774
9	9.239	27.581	0.0	1.630	0.679	6.793
21	0.0	0.0	0.0	0.0	0.0	0.0
18	0.0	0.0	0.098	0.0	0.0	0.0
16	0.0	0.0	0.0	0.0	0.0	0.0
15	18.723	1.418	0.0	10.780	2.688	13.617
33	1.654	0.382	2.417	0.636	2.036	2.926
27	1.748	1.282	1.282	0.816	2.214	0.233
37	11.719	8.984	17.578	4.102	6.641	4.102
28	0.110	0.110	5.232	0.0	0.119	0.0
23	19.207	14.939	6.402	7.470	7.317	2.591
34	32.335	12.096	26.467	18.683	41.437	5.868
17	0.030	0.626	0.939	0.0	0.782	1.095
29	0.238	0.713	0.950	0.475	0.594	0.0
1	6.238	4.253	].647	22.873	253.308	0.0
6	0.0	0.0	0.0	0.0	0.0	0.0
3	0.0	0.0	0.0	0.0	0.0	0.0
32	1.794	0.478	1.675	0.120	0.957	1.196
26	0.327	6.373	1.307	26.961	8.170	3.758
11	53.370	0.275	0.0	0.413	0.0	0.0
35	4.925	].141	15.846	0.642	4.283	1.713
22	0.0	0.829	0.415	0.518	0.933	0.518
36	2.093	1.332	1.808	0.476	1.713	0.285
19	0.0	0.0	192.321	0.0	0.0	0.0
30	0.238	3.325	0.0	7.007	4.276	0.0
5	0.087	0.173	0.173	0.087	0.519	0.0
24	1.534	0.837	3.068	0.837	1.116	0.558
31	5.488	3.293	0.998	0.998	4.391	2.183
25	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	0.0	0.0	0.0

(Table 5.5 - Continued)

Producing Industry	Using Industry 4	7	38	9	21	18
12	0.0	0.0	5.832	0.0	0.0	0.0
15	0.0	0.0	0.0	0.329	0.0	0.0
20	0.0	0.0	6.250	0.0	0.0	2.273
10	0.0	0.0	2.660	0.484	0.0	0.0
8	0.0	0.0	9.839	0.484	0.0	0.0
13	0.0	0.0	1.901	0.0	0.0	0.0
4	0.0	0.0	1.300	0.0	0.0	0.0
7	0.0	67.216	13.024	1.647	0.0	11.527
38	8.913	3.922	209.269	9.447	2.565	2.565
9	0.0	3.533	3.397	4.755	0.0	0.272
21	0.0	0.0	14.791	0.0	2.908	0.0
18	0.0	0.0	0.687	0.0	0.785	46.320
15	0.0	0.0	0.0	0.0	0.0	0.0
14	0.0	0.426	2.128	5.248	0.0	0.142
33	6.870	2.290	222.519	1.272	0.891	0.891
27	12.238	1.748	61.422	0.932	0.583	0.699
37	13.086	6.836	121.289	12.109	6.055	6.445
28	0.119	0.119	36.861	0.238	0.119	0.119
23	0.305	2.896	24.238	10.061	1.220	3.659
34	31.497	109.102	200.359	41.916	14.850	18.563
17	1.878	0.782	2.191	0.782	0.939	2.034
29	5.938	1.188	11.639	0.475	0.356	0.475
1	0.189	390.737	32.514	22.779	0.095	5.577
6	1.661	0.0	0.0	0.0	0.0	0.0
3	0.0	0.0	0.417	58.081	0.0	0.0
32	15.909	13.397	27.871	1.077	2.990	0.718
26	17.974	14.706	62.582	13.725	12.255	5.882
11	0.0	0.0	2.063	4.264	0.0	0.0
35	2.355	4.925	92.291	6.424	4.069	4.069
22	7.979	0.725	12.642	0.622	13.990	3.005
36	28.639	1.427	51.094	1.142	0.951	0.761
19	0.518	0.0	5.177	0.0	12.425	1.122
30	2.850	0.950	6.176	2.019	0.0	0.238
5	1.817	0.173	4.671	0.173	0.0	0.0
24	0.418	0.837	239.470	1.674	0.558	0.697
31	9.440	2.183	27.552	3.622	1.317	0.988
25	0.0	0.0	0.684	0.0	0.0	0.0
2	0.0	0.0	0.0	0.0	0.089	0.0

(Table 5.5 - Continued)

Pro-ducing Industry	Using Industry					
	16	15	33	17	37	28
12	0.0	0.0	0.0	0.0	0.0	0.0
14	0.0	0.0	0.0	0.0	0.0	0.0
20	0.0	0.0	0.0	3.788	0.0	0.0
10	0.0	0.121	0.0	0.0	0.0	0.0
8	0.0	5.161	0.0	0.0	0.0	0.161
13	0.0	0.0	0.0	0.0	0.0	0.0
4	0.0	0.0	0.0	0.591	0.0	9.929
7	0.0	1.048	0.0	0.0	0.0	0.0
38	10.339	4.635	83.601	12.299	120.321	7.843
9	0.0	5.842	0.0	0.0	0.0	0.0
21	0.0	0.0	1.770	1.517	7.332	0.0
18	0.0	0.0	0.0	0.785	0.0	0.785
16	40.135	0.0	0.0	0.0	0.0	0.0
15	0.0	16.170	0.0	0.0	0.0	0.0
33	0.509	0.891	3.435	6.743	343.511	1.272
27	0.466	0.816	21.445	96.387	8.392	0.816
37	5.273	5.859	100.000	21.094	406.836	13.086
28	0.0	0.119	7.015	6.302	0.832	12.128
23	8.537	10.976	89.634	4.268	0.0	6.098
34	10.659	11.377	563.233	65.629	27.784	15.689
17	0.156	0.156	8.920	33.020	0.0	0.626
29	0.238	0.594	110.570	36.342	4.157	0.594
1	47.826	10.964	2.741	0.0	0.945	0.095
6	0.0	0.119	24.674	0.119	0.949	0.0
3	0.0	0.0	0.0	0.0	0.0	0.0
32	0.837	0.837	94.976	9.928	0.0	3.947
26	2.614	1.797	486.601	140.523	0.0	3.105
11	0.0	0.413	0.0	0.0	0.0	0.0
35	0.214	1.141	18.844	7.495	27.837	6.638
22	0.725	0.0	278.964	7.565	0.0	1.865
36	0.285	0.571	10.942	4.377	13.701	0.761
19	0.0	1.208	0.690	5.349	0.0	1.208
30	0.0	0.0	146.675	7.957	0.0	0.119
5	0.0	0.346	1.644	0.346	5.190	0.087
24	0.558	1.116	5.300	1.116	29.986	0.976
31	1.098	1.756	33.260	11.416	11.087	3.403
25	0.0	0.0	53.762	65.800	0.0	0.547
2	0.0	0.0	6.768	0.178	0.0	0.0

(Table 5.5 - Continued)

Producing Industry	Using Industry 23	34	17	29	1	6
21	0.0	0.0	0.0	0.0	0.0	0.0
14	0.0	0.0	0.0	0.0	0.0	0.0
20	0.0	2.462	0.379	0.0	0.0	0.0
10	0.0	0.0	0.0	0.0	0.0	0.0
8	0.0	0.0	0.0	0.0	0.0	0.0
13	0.0	0.0	0.0	0.0	0.0	0.0
4	0.591	0.0	0.118	6.028	0.0	0.473
7	0.0	0.0	0.0	0.0	0.150	0.0
38	15.865	226.560	7.130	11.052	0.357	1.070
9	0.0	0.0	0.0	0.0	0.0	0.0
21	0.0	15.550	0.0	4.298	0.0	0.0
18	0.883	0.981	0.589	0.0	0.883	0.0
16	0.0	0.0	0.0	0.0	0.0	0.0
15	0.0	0.0	0.0	0.0	0.851	0.0
33	11.069	247.710	0.763	2.545	63.359	].163
27	14.103	122.960	1.282	2.565	20.746	5.594
37	33.594	285.156	15.234	15.430	148.047	2.734
28	0.357	23.306	0.110	0.951	0.0	0.0
23	193.140	57.927	2.134	5.183	3.201	1.829
34	76.886	232.216	11.617	30.778	142.395	6.228
17	0.469	20.031	1.565	2.504	26.604	0.313
29	10.570	0.264	0.950	30.285	0.0	0.0
1	15.690	2.741	0.0	0.0	71.078	0.0
6	5.101	1.186	0.119	0.0	1.186	0.0
3	0.0	0.0	0.0	0.0	0.0	0.0
32	14.593	6.699	10.646	6.220	45.335	0.837
26	18.791	38.725	3.105	69.771	60.621	1.634
11	0.0	0.0	0.0	0.0	252.682	0.0
35	19.058	59.529	4.711	8.351	0.0	0.0
22	1.865	14.404	0.0	3.523	0.415	1.244
36	22.550	23.406	1.237	2.188	4.282	1.332
19	7.420	4.659	18.982	2.588	9.922	0.0
30	3.088	8.195	0.0	2.375	0.356	0.0
5	3.460	26.038	0.0	0.0	0.0	1.125
24	2.929	49.512	0.697	1.255	0.0	0.279
31	16.026	59.934	2.634	3.513	117.124	2.525
25	0.274	0.0	10.944	0.0	0.0	0.0
2	191.986	0.0	0.0	0.0	0.356	0.0

(Table 5.5 - Continued)

Producing Industry	Using Industry 3	32	26	11	35	22
12	0.0	0.0	0.0	0.0	0.0	0.0
14	0.0	0.876	0.0	0.876	0.0	0.0
20	0.0	0.0	0.0	0.0	0.0	0.0
10	0.0	0.0	0.0	0.0	0.0	0.0
8	0.0	0.484	0.0	1.129	0.0	0.0
13	0.0	0.0	0.0	0.0	0.0	0.0
4	0.0	3.664	67.730	0.0	0.0	0.0
7	0.0	12.575	0.0	10.329	0.0	0.0
38	0.0	25.847	27.094	13.547	16.221	7.665
9	0.0	1.495	0.0	8.696	0.0	0.272
21	0.0	0.0	0.0	0.0	0.759	0.0
18	0.0	0.0	0.491	0.0	0.0	0.0
16	0.0	0.0	0.0	0.0	0.0	0.0
15	0.0	0.426	0.0	1.560	0.0	0.0
33	0.0	4.962	13.359	1.145	15.140	6.361
27	3.380	5.012	10.606	1.166	3.030	5.128
37	2.539	27.930	47.266	6.055	11.523	17.383
28	2.616	0.357	0.357	0.119	1.308	0.238
23	0.0	19.207	6.250	20.427	0.610	1.677
34	5.030	54.012	108.623	157.844	27.305	75.210
17	0.0	0.626	10.485	0.0	1.408	0.156
29	0.0	2.563	10.095	0.475	8.076	2.969
1	0.0	21.834	0.095	144.045	0.0	12.287
6	0.0	3.677	1.305	0.237	0.0	0.0
3	1.043	0.0	0.0	0.0	0.0	0.0
32	0.359	57.655	4.785	10.048	0.120	4.785
26	0.817	14.869	174.183	1.797	1.307	12.582
11	0.0	0.275	0.0	31.499	0.0	0.0
35	0.0	10.278	16.702	5.353	64.026	10.064
22	0.933	4.560	10.777	0.0	0.207	33.782
36	0.095	7.707	8.088	2.093	1.142	3.235
19	3.106	0.863	0.604	4.055	0.863	0.863
30	0.356	6.057	2.138	0.238	0.238	0.0
5	0.0	0.346	0.260	0.087	0.0	0.087
24	0.0	2.929	2.068	2.371	6.276	0.837
31	5.269	19.868	14.270	1.647	4.501	6.696
25	0.0	0.958	193.023	0.0	0.0	0.0
2	0.0	0.0	0.0	0.0	0.0	162.155

(Table 5.5 - Continued)

Producing Industry	Using Industry 36	19	30	5	24	31
12	0.0	0.0	0.0	0.0	0.0	0.0
14	0.0	0.0	0.0	0.0	0.0	0.0
20	0.0	0.0	0.0	0.0	0.0	0.0
10	0.0	0.0	0.0	0.0	0.0	0.0
8	0.0	0.0	0.0	0.0	0.0	0.0
13	0.0	0.0	0.0	0.0	0.0	0.0
4	1.537	0.0	0.0	0.0	0.0	0.0
7	0.0	0.150	0.0	0.0	0.0	0.0
38	2.674	4.100	3.209	1.426	9.982	7.665
9	0.0	0.679	0.408	0.0	0.0	0.0
21	0.379	0.0	0.0	0.0	0.0	0.0
18	0.0	0.785	0.0	0.0	0.0	0.0
16	0.0	0.0	0.0	0.0	0.0	0.0
15	0.0	0.0	0.0	0.0	0.0	0.0
33	33.206	4.580	1.908	3.308	1.781	3.817
27	1.282	3.147	4.429	3.963	0.699	3.147
37	2.539	14.648	8.984	3.711	22.461	31.250
28	0.476	0.238	0.238	0.0	0.238	0.238
23	1.524	8.384	7.165	0.0	103.963	2.287
34	16.287	27.305	22.635	4.311	19.163	55.928
17	0.313	1.408	0.626	0.626	0.313	2.660
29	7.838	2.375	3.800	0.0	0.475	2.375
1	0.0	1.796	0.473	0.0	0.0	0.0
6	0.0	0.119	12.456	0.0	0.0	0.356
3	0.0	0.0	0.0	0.0	0.0	0.0
32	9.091	11.603	2.512	1.077	6.699	1.914
26	5.229	4.575	4.739	2.614	0.654	4.739
11	0.0	0.0	0.0	0.0	0.0	0.0
35	0.857	4.925	1.499	0.428	13.490	4.283
22	5.596	1.554	1.036	0.0	0.0	0.0
36	87.821	4.186	5.328	3.996	1.808	2.034
19	0.0	109.318	0.863	0.0	0.0	0.0
30	0.356	0.238	11.520	0.0	0.0	0.0
5	7.093	0.606	1.471	0.779	0.173	56.401
24	1.116	0.976	0.558	0.697	39.052	1.116
31	10.318	1.647	9.330	2.415	2.634	27.552
25	0.137	0.0	1.778	0.0	0.0	0.0
2	0.0	0.0	0.0	0.0	0.0	0.0

(Table 5.5 - Continued)

Producing Industry	Using Industry 25	2
12	0.0	0.0
14	0.0	0.0
20	0.0	0.0
10	0.0	0.0
8	0.0	0.0
13	0.0	0.0
4	9.693	0.0
7	0.0	0.0
38	2.317	0.0
9	2.317	0.0
21	0.0	0.0
18	0.0	0.0
16	0.0	0.0
15	0.0	0.0
33	6.870	7.634
27	4.312	6.061
37	4.687	2.344
28	0.0	0.0
23	0.610	0.0
34	29.222	14.132
17	0.469	0.156
29	2.850	0.0
1	0.0	5.198
6	4.033	0.0
3	0.0	0.0
32	0.957	0.120
26	3.595	23.856
11	0.0	0.0
35	1.499	0.0
22	0.415	0.415
36	10.942	0.095
19	0.0	1.467
30	1.188	0.0
5	0.692	0.0
24	0.279	0.0
31	32.821	15.807
25	40.219	0.0
2	0.0	0.0

Note: Industries are arranged in increasing order of w_i.

TABLE 5.6

1961 INPUT-OUTPUT TABLE
ARRANGED IN A QUASI TRIANGULAR MATRIX
Millions of Dollars

Pro-ducing Industry	Using Industry					
	14	20	12	21	33	10
14	15.253	0.0	0.0	0.366	0.0	0.0
20	0.0	79.926	0.0	0.366	0.0	0.0
12	0.0	0.0	0.462	0.0	0.0	0.0
21	0.0	1.038	0.0	8.425	21.051	0.0
33	2.179	1.038	1.385	1.099	7.017	1.006
10	0.436	0.0	8.309	0.0	0.0	14.422
8	0.0	0.0	5.539	0.0	0.0	2.012
16	0.0	0.0	0.0	0.0	0.0	0.0
18	0.0	1.038	0.0	0.733	0.0	0.0
13	0.0	0.0	0.0	0.0	0.0	0.0
37	3.922	21.798	8.309	6.593	63.154	3.689
7	0.872	0.0	14.310	0.0	0.0	10.062
27	0.436	1.038	0.462	0.733	35.085	1.006
15	0.872	0.0	16.156	0.0	0.0	9.391
9	17.868	1.038	17.541	0.0	0.0	4.025
34	19.175	60.204	29.542	27.106	701.709	21.466
28	0.436	15.570	0.462	5.861	42.103	0.671
6	0.0	0.0	0.462	0.0	49.120	0.335
29	0.436	1.038	0.462	2.564	224.547	1.006
23	16.125	11.418	29.081	6.960	70.171	14.087
4	0.0	0.0	0.0	0.733	7.017	0.335
35	1.743	4.152	1.385	2.564	21.051	1.677
31	2.179	1.038	5.078	0.733	91.222	1.006
22	2.615	0.0	0.0	26.740	357.872	0.0
32	2.179	4.152	9.694	5.128	56.137	3.019
5	0.436	0.0	0.462	0.366	0.0	0.671
36	4.358	3.114	3.693	2.198	7.017	2.012
26	6.973	1.038	0.462	17.949	701.709	28.509
38	64.934	43.596	34.158	18.681	287.701	27.503
1	16.125	9.342	3.231	0.366	14.034	49.639
17	0.0	3.114	0.0	5.861	21.051	0.0
24	4.358	0.0	0.462	0.366	0.0	0.0
11	3.051	0.0	58.623	0.0	0.0	0.335
3	0.0	11.418	0.0	0.0	0.0	0.0
19	0.0	231.474	0.0	21.245	35.085	0.0
30	13.510	0.0	0.0	].564	371.906	7.379
25	0.0	0.0	0.0	4.396	105.256	0.335
2	0.436	0.0	0.0	0.733	21.051	0.0

(Table 5.6 - Continued)

Pro-ducing Industry	Using Industry 8	16	18	13	37	7
14	0.0	0.0	0.0	0.175	0.0	0.0
20	0.0	0.0	1.476	0.0	0.0	0.0
12	0.0	0.0	0.0	0.0	0.0	0.0
21	0.0	0.0	0.0	0.0	0.0	0.0
33	2.750	1.340	0.591	0.702	504.573	2.563
10	1.833	0.0	0.0	0.0	0.0	1.282
8	61.419	0.0	0.0	0.175	0.0	1.282
16	0.0	73.700	0.0	0.0	0.0	0.0
18	0.0	0.0	51.677	0.0	0.0	0.0
13	0.0	0.0	0.0	17.891	0.0	0.0
37	7.334	4.355	3.544	3.157	353.856	2.563
7	0.917	1.340	18.013	0.175	0.0	157.637
27	0.917	0.335	0.295	0.175	0.0	1.282
15	4.583	0.335	0.0	12.103	0.0	0.0
9	5.500	0.0	0.886	1.228	0.0	23.069
34	23.834	8.710	20.966	5.437	26.212	85.867
28	0.917	2.010	5.020	0.175	0.0	0.0
6	0.0	0.0	0.0	0.0	0.0	0.0
29	0.0	0.0	0.295	0.175	0.0	0.0
23	22.001	23.450	4.725	1.403	0.0	19.224
4	0.0	0.0	0.0	0.0	0.0	0.0
35	2.750	0.670	1.476	0.877	58.976	3.845
31	6.417	0.335	0.295	1.579	6.553	1.282
22	0.917	1.005	0.886	0.0	0.0	1.282
32	3.667	0.0	6.497	].456	6.553	6.408
5	0.917	0.0	0.295	0.175	0.0	0.0
36	5.500	0.670	1.476	1.052	19.659	6.408
26	7.334	1.005	].067	3.859	6.553	3.845
38	49.502	24.790	25.396	22.451	399.727	39.730
1	442.766	92.125	0.591	0.175	13.106	622.857
17	0.0	0.0	9.154	0.0	0.0	0.0
24	0.0	1.005	0.0	0.877	6.553	0.0
11	0.0	0.0	0.0	0.0	0.0	1.282
3	0.0	0.0	0.0	0.0	0.0	0.0
19	0.0	0.0	6.497	0.0	0.0	1.282
30	2.750	0.0	0.295	0.351	0.0	0.0
25	0.0	0.0	0.295	0.0	0.0	0.0
2	0.0	0.0	0.0	0.175	0.0	0.0

(Table 5.6 - Continued)

Pro-ducing Industry	Using Industry 27	15	9	34	28	6
14	0.0	0.0	0.693	0.0	0.0	0.0
20	0.0	0.0	0.0	21.256	0.649	0.0
12	0.0	0.275	0.0	0.0	0.0	0.0
21	1.945	0.0	0.0	0.0	0.649	0.0
33	11.671	1.098	2.078	212.556	2.594	2.461
10	0.0	0.549	2.771	0.0	0.0	0.0
8	0.0	3.844	3.463	10.628	0.0	0.0
16	0.0	0.0	0.0	0.0	0.0	0.0
18	0.0	0.0	0.0	0.0	1.946	0.0
13	0.0	0.0	0.0	0.0	0.0	0.0
37	11.671	3.021	6.234	478.251	16.215	4.648
7	0.0	0.275	9.005	0.0	0.649	0.0
27	365.698	0.275	0.693	53.139	1.946	0.273
15	0.0	19.771	8.312	0.0	0.0	0.0
9	0.0	4.119	42.947	0.0	0.649	0.0
34	95.315	14.279	42.947	648.295	25.295	11.209
28	15.562	0.275	0.693	10.628	16.215	0.273
6	0.0	0.275	0.693	0.0	0.0	1.094
29	29.178	0.275	0.693	10.628	5.189	0.273
23	5.836	15.103	25.630	85.022	15.566	5.468
4	7.781	0.0	0.0	0.0	17.512	0.273
35	9.726	0.824	2.771	223.184	5.837	0.820
31	3.890	1.098	2.771	244.439	1.946	7.108
22	3.890	0.0	1.385	10.628	10.378	0.547
32	13.616	3.021	15.239	10.628	46.699	4.648
5	1.945	0.549	0.693	10.628	0.649	2.461
36	9.726	1.648	4.156	106.278	3.892	6.288
26	108.931	0.824	8.312	31.883	25.944	2.187
38	105.041	17.300	58.187	945.874	66.806	31.441
1	0.0	16.476	85.895	201.928	0.649	0.0
17	36.959	0.0	0.0	31.883	1.297	0.0
24	0.0	0.275	0.0	10.628	0.649	0.0
11	0.0	0.824	10.390	10.628	0.0	0.0
3	0.0	0.0	78.275	0.0	0.0	0.0
19	17.507	0.824	1.385	31.883	7.135	1.094
30	19.452	0.275	4.156	0.0	7.135	0.273
25	52.520	0.0	1.385	10.628	7.135	0.0
2	0.0	0.0	0.0	10.628	0.0	0.0

(Table 5.6 - Continued)

Producing Industry	Using Industry 29	23	4	35	31	22
14	0.0	0.0	0.0	0.0	0.0	0.0
20	0.0	0.0	0.0	0.0	0.0	0.0
12	0.0	0.0	0.0	0.0	0.0	0.0
21	9.030	2.228	0.0	0.0	0.0	3.179
33	3.870	8.914	22.669	35.955	26.088	6.356
10	0.0	0.0	0.0	0.0	0.0	0.0
8	0.0	0.0	0.0	0.0	0.0	0.0
16	0.0	0.0	0.0	0.0	0.0	0.0
18	0.0	0.0	0.0	0.0	0.0	0.0
13	0.0	0.0	0.0	0.0	0.0	0.0
37	28.380	22.285	17.632	14.607	11.181	13.776
7	0.0	0.0	0.0	0.0	0.0	0.0
27	6.450	2.228	2.519	1.124	1.242	1.060
15	0.0	0.0	0.0	0.0	0.0	0.0
9	0.0	4.457	0.0	0.0	1.242	1.060
34	49.020	106.968	55.414	68.540	111.807	79.477
28	9.030	6.685	2.519	1.124	2.485	1.060
6	0.0	6.685	5.038	0.0	1.242	0.0
29	147.060	2.228	2.519	7.865	1.242	1.060
23	11.610	283.019	0.0	0.0	1.242	3.179
4	19.350	2.228	816.091	0.0	8.696	0.0
35	11.610	8.914	2.519	24.719	1.242	4.239
31	2.580	22.285	12.594	2.247	12.423	8.478
22	2.580	42.341	0.0	0.0	0.0	117.627
32	21.930	53.484	27.707	0.0	32.300	10.597
5	1.290	15.599	20.150	0.0	404.990	0.0
36	7.740	69.083	57.932	3.371	9.938	10.597
26	110.940	15.599	35.263	1.124	7.454	6.358
38	79.980	120.339	95.714	65.169	21.119	55.104
1	1.290	24.513	0.0	0.0	0.0	21.194
17	12.900	0.0	0.0	0.0	0.0	0.0
24	0.0	6.685	0.0	7.865	0.0	0.0
11	0.0	0.0	0.0	0.0	0.0	0.0
3	0.0	0.0	0.0	0.0	0.0	0.0
19	2.580	13.371	0.0	1.124	0.0	1.060
30	9.030	4.457	7.556	0.0	0.0	3.179
25	34.830	2.228	17.632	0.0	0.0	1.060
2	0.0	314.218	0.0	0.0	0.0	288.238

(Table 5.6 - Continued)

Producing Industry	Using Industry 32	5	36	26	38	1
14	1.498	0.0	0.0	0.0	29.433	0.0
20	0.0	0.0	0.0	0.0	7.358	0.0
12	0.0	0.0	0.0	0.0	58.866	0.0
21	0.0	0.0	0.0	0.0	0.0	0.0
33	10.483	12.272	56.808	14.340	22.075	59.282
10	0.0	0.0	0.0	0.0	36.791	0.0
8	1.498	0.0	0.0	0.0	95.658	0.0
16	0.0	0.0	0.0	0.0	0.0	0.0
18	0.0	0.0	0.0	0.0	7.358	0.0
13	0.0	0.0	0.0	0.0	22.075	0.0
37	22.464	144.639	30.298	43.020	198.674	90.483
7	4.493	0.0	0 .0	0.0	110.374	3.120
27	2.995	0.877	0.0	14.340	80.941	3.120
15	0.0	0.0	0.0	0.0	14.717	0.0
9	25.459	0.0	0.0	0.0	36.791	9.360
34	79.373	21.038	11.362	120.456	890.354	174.726
28	8.986	0.0	0.0	8.604	73.583	0.0
6	13.478	0.877	0.0	2.868	0.0	0.0
29	1.498	0.877	0.0	43.020	73.583	3.120
23	40.435	0.0	1.262	14.340	73.583	3.120
4	8.986	0.877	1.262	180.684	7.358	0.0
35	10.483	4.383	5.050	22.944	147.166	12.480
31	43.430	7.013	7.574	8.604	29.433	137.284
22	1.498	0.877	1.262	8.604	14.717	6.240
32	205.171	4.383	0.0	20.076	154.524	65.522
5	8.986	14.902	5.050	2.868	0.0	3.120
36	35.942	15.779	236.069	22.944	22.075	24.961
26	19.469	10.519	1.262	304.008	242.824	28.081
38	166.233	80.647	34.085	172.080	1022.803	109.203
1	1.498	4.383	1.262	0.0	66.225	137.284
17	2.995	0.0	0.0	5.736	73.583	6.240
24	0.0	0.0	0.0	2.868	478.289	0.0
11	1.498	0.0	0.0	0.0	14.717	246.488
3	0.0	0.0	0.0	0.0	0.0	0.0
19	4.493	0.0	0.0	0.0	29.433	9.360
30	13.478	0.0	0.0	8.604	14.717	0.0
25	4.493	0.0	1.262	384.312	7.358	0.0
2	1.498	0.0	0.0	0.0	7.358	9.360

(Table 5.6 - Continued)

Producing Industry	Using Industry 17	24	11	3	19	30
14	0.0	0.0	1.696	0.0	0.0	0.0
20	1.018	0.0	0.0	0.0	11.493	0.0
12	0.0	0.0	0.0	0.0	0.0	0.0
21	0.0	0.0	0.0	0.0	0.884	0.0
33	1.018	2.624	1.131	6.445	4.420	4.878
10	0.0	0.0	0.565	0.0	0.0	0.0
8	0.0	0.0	1.696	0.0	0.0	0.0
16	0.0	0.0	0.0	0.0	0.0	0.0
18	2.376	0.0	0.0	0.0	0.0	0.0
13	0.0	0.0	0.0	0.0	0.0	0.0
37	5.771	16.621	3.393	2.191	10.609	9.755
7	0.339	0.0	11.875	0.0	0.0	0.0
27	0.679	0.875	0.565	1.289	0.884	0.697
15	0.0	0.0	4.524	0.0	0.0	0.0
9	0.679	0.0	31.102	0.0	4.420	0.697
34	13.919	23.620	70.688	7.476	43.321	53.654
28	1.697	1.750	0.565	0.644	3.536	2.090
6	0.339	0.0	0.565	0.129	0.0	26.478
29	0.339	0.0	0.565	0.773	0.884	1.394
23	4.074	144.342	13.006	0.129	16.798	16.026
4	1.697	0.0	0.0	0.0	0.884	8.362
35	2.037	18.371	1.696	0.258	3.536	4.181
31	1.018	1.750	1.131	5.285	3.536	9.058
22	0.339	0.875	0.0	1.289	1.768	1.394
32	39.721	10.498	6.220	0.387	38.016	11.846
5	1.018	0.0	0.0	0.0	1.768	5.574
36	3.395	4.374	3.958	0.129	7.957	21.601
26	3.734	3.499	2.827	2.062	2.652	6.271
38	24.104	70.859	26.013	0.258	49.510	74.558
1	0.339	0.875	210.366	0.129	3.536	0.0
17	7.469	0.0	0.0	0.0	4.420	0.697
24	0.0	55.987	0.0	0.0	0.0	0.0
11	0.0	0.0	37.232	0.0	0.0	0.0
3	0.0	0.0	0.565	1.547	0.0	0.0
19	22.067	3.499	6.786	2.707	175.936	2.090
30	0.339	0.0	0.0	0.129	0.884	64.106
25	0.339	0.0	0.565	0.0	0.0	2.787
2	0.0	0.0	0.565	0.0	0.0	0.697

(Table 5.6 - Continued)

Producing Industry	Using Industry 25	2
14	0.0	0.0
20	0.0	0.0
12	0.0	0.0
21	0.0	0.0
33	3.935	18.892
10	0.0	0.0
8	0.0	0.0
16	0.0	0.0
18	0.0	0.0
13	0.0	0.0
37	3.148	64.069
7	0.0	0.0
27	0.787	0.821
15	0.0	0.0
9	0.787	0.0
34	46.433	41.891
28	0.787	0.0
6	3.148	0.0
29	0.787	0.821
23	1.574	0.0
4	119.624	0.0
35	2.361	3.286
31	9.444	19.714
22	1.574	0.821
32	3.935	1.643
5	25.971	0.0
36	20.462	1.643
26	15.740	6.571
38	61.386	121.567
1	0.0	9.035
17	0.0	0.0
24	0.0	0.0
11	0.0	5.750
3	0.0	0.0
19	0.0	0.821
30	12.592	0.0
25	33.841	0.0
2	0.787	82.961

Note: Sectors are arranged in increasing order of w_i.

TABLE 5.7

ORDERING OF INDUSTRIES IN TRIANGULAR ARRANGEMENT

Industry (Compromise Ranking)	Year 1949	Ranking 1961
1 - Bakery Products (12)	1	3
2 - Carbonated Beverages (13)	6	1
3 - Fruit & Vegetable Preparations (10)	2	7
4 - Alcoholic Beverages (14)	4	5
5 - Leather Products (18)	11	2
6 - Dairy Products (8)	5	9
7 - Furniture (21)	3	11
8 - Clothing (20)	12	4
9 - Tobacco & Products (16)	9	8
10 - Confectionery & Sugar Refining (15)	8	15
11 - Fish Processing	10	14
12 - Meat Products (7)	14	12
13 - Construction (33)	18	10
14 - Metal Mining & Smelting (4)	7	22
15 - Transportation Equipment (27)	19	13
16 - Fishing, Hunting & Trapping (3)	16	17
17 - Grain Mill Products (11)	28	6
18 - Non-Metallic Mineral Products (30)	20	20
19 - Miscellaneous Manufacturing Industries (28)	21	19
20 - Textile Products (19)	17	23
21 - Wood Products (22)	25	16
22 - Electrical Apparatus & Supplies (29)	24	18
23 - Agriculture (1)	15	27
24 - Paper Products (23)	23	24
25 - Rubber Products (17)	27	21
26 - Service Industries (38)	13	36
27 - Non-Metal Mining (6)	26	25
28 - Printing & Publishing (24)	22	30
29 - Transportation Storage & Trade (34)	31	26
30 - Agricultural Implements (26)	30	28
31 - Chemicals (32)	29	35
32 - Communication (35)	34	31
33 - Finance & Insurance (37)	33	34
34 - Forestry (2)	35	32
35 - Coal Mining, Petroleum & Natural Gas (5)	38	29
36 - Peimary Iron & Steel (25)	32	37
37 - Products of Petroleum and Coal (31)	37	33
38 - Electricity, Water and Gas (36)	36	38

Note: Number in brackets are original code numbers of industries from Table 5.1.

TABLE 5.8

INDEXES OF POWER AND SENSITIVITY OF DISPERSION

Industry	Index of Power of Dispersion 1949 D_j	1961 D_j	Indexes of Sensitivity of Dispersion 1949 S_j	1961 S_i
1	1.00	.95	1.95	2.26
2	.80	.98	1.00	1.07
3	.80	.78	.72	
4	.85	1.01	.73	1.21
5	.79	.85	.78	.95
6	.85	.83	.68	.60
7	1.23	1.28	.80	.80
8	1.14	1.22	.66	.65
9	1.02	1.11	.77	.78
10	1.29	1.14	.63	.60
11	1.33	1.29	1.00	.88
12	1.21	1.12	.61	.56
13	.98	.97	.65	.61
14	1.02	1.00	.63	.58
15	.88	.91	.80	.69
16	1.40	1.30	.80	.69
17	.89	.94	.74	.67
18	1.17	1.11	.78	.66
19	.97	.96	1.18	1.08
20	1.02	1.00	.64	.61
21	.98	.99	.64	.57
22	1.10	1.13	.97	.80
23	.98	1.05	1.39	1.32
24	1.02	.95	.94	.84
25	.94	.99	.94	.85
26	.92	1.02	1.69	1.32
27	1.00	1.01	1.01	.79
28	.92	.98	.70	.68
29	.97	.98	.83	.76
30	.95	.99	.77	.77
31	.91	1.00	1.22	.95
32	1.03	1.03	1.01	1.25
33	1.14	1.00	1.29	1.02
34	.88	.84	2.99	2.73
35	.82	.73	1.04	.83
36	1.04	.81	1.04	1.09
37	.84	.74	1.85	1.48
38	.84	1.08	1.34	3.36

Note: The figures have been calculated from relations (2.23) and (2.23). The numbering of industries is in accordance with Table 5.1.

TABLE 5.9

MEASURES OF VARIANCE OF INDEXES OF POWER AND SENSITIVITY OF DISPERSION

Industry	1949 V_j	1961 V_j	1949 V_i	1961 V_i
1	3.81	3.97	2.39	2.04
2	4.69	3.80	3.86	3.56
3	4.71	4.28	5.30	5.24
4	4.55	4.85	5.13	4.07
5	4.75	3.97	4.83	3.66
6	4.38	4.00	5.56	5.48
7	3.48	3.28	4.99	4.69
8	3.57	3.23	5.85	5.40
9	3.75	3.18	4.91	4.52
10	3.03	3.05	6.12	5.78
11	3.25	3.05	4.22	4.17
12	3.14	2.97	6.15	5.86
13	4.07	3.82	6.16	6.05
14	3.76	3.44	6.11	5.95
15	4.51	3.88	4.99	5.14
16	3.40	3.41	6.16	6.16
17	4.24	3.62	5.12	5.06
18	4.04	3.60	6.05	6.03
19	4.81	4.29	4.09	3.91
20	3.92	3.68	6.02	5.86
21	3.88	3.39	5.92	5.99
22	3.69	3.41	4.39	4.61
23	3.34	3.65	3.07	2.86
24	4.07	3.82	4.83	4.22
25	4.40	3.57	4.41	4.09
26	4.18	3.71	2.42	2.80
27	4.07	4.04	4.00	5.17
28	4.28	3.46	5.61	4.95
29	4.12	3.83	4.75	4.87
30	4.13	3.71	5.07	4.69
31	4.37	3.50	3.18	3.48
32	3.96	3.76	4.04	3.02
33	3.40	3.36	2.92	3.21
34	4.55	4.34	1.29	1.23
35	5.05	4.65	3.95	4.02
36	4.47	5.05	4.44	3.67
37	4.97	4.76	2.18	2.32
38	4.63	3.72	2.85	1.11

Note: The figures have been calculated from relations (2.24) and (2.25). The numbering of industries is the same as in Tables (5.1) and (5.2).

Average $\overline{V}_j(1949) = 4.09$ $\overline{V}_j(1961) = 3.69$ $\overline{V}_i(1949) = 4.56$, $\overline{V}_i(1961) = 4.33$.

inclusive indexes of the power of dispersion D_j and sensitivity of dispersion S_i. In table 5.8 these indexes are shown for the years 1961 and are adjusted in terms of 1961 prices. Table 5.9 shows similar results for the indexes of variance V_j and V_i.

A comparison between the D_j indexes relating to 1949 and those relating to 1961 shows that some sectors have undergone a greater relative change than others. To get an idea of such relative changes we could for example, look at the sectors whose D_j indexes show a difference, between the two years, whose value is included in the upper or lower quartile of the distribution of D_j differences for all 38 industries.[1] This means, to consider those industries whose D_j index shows a difference, for the two years of $\pm$ .06 or greater. A smaller difference would exclude an industry from being included in either quartile.

Using this criterion we can look first at the industries that show the greatest relative increase in their D_j index between 1949 and 1961.

These are the following nine industries.[2]

28	23	8	9	31	26	4	2	38
(0.06)	(0.07)	(0.08)	(0.09)	(0.09)	(0.10)	(0.16)	(0.18)	(0.24).

[1] The upper and lower limits of the D_j differences for all 38 industries between the two years are 0.24 and -0.23.

[2] The 9 industries are written in order of increasing D_j differences with each difference written in parenthesis under the corresponding industry.

Starting from the industry that shows the greatest increase, we note that it is that of the "service" industry (industry 38). It will be recalled that this was an industry that also showed a fair improvement when we examined its u_j index. The reasons for such improvement were then explained. The same reasons apply for the improvement of the D_j index since this index is also influenced by the magnitude of the inputs to the service industry. The difference between the u_j and D_j indexes, as has already been discussed, is that the D_j index is also influenced by the size of the inputs to the industries whose outputs are used as inputs to industry 38. The improvement therefore of the D_j index means that the service industry has generated demand not only from its supplying industries but also from their own suppliers.

The industry showing the second largest improvement is the "forestry" industry (industry 2). Here again the improvement in the D_j index could be explained on the basis of what was said about the improvement of the u_j index for that industry. It was noted there that the forestry industry's inputs from the "service" industry has increased and had thus contributed to the increase of the u_j index of forestry. But since it was found that the u_j index of the forestry industry will increase since this index considers also such inputs as those going to the service industry; a supplier of the "forestry" industry.

The improvement in the D_j index of industry 4 (metal mining smelting and refining) is most likely due to the change

in that industry's definition, mentioned earlier when its u_j index was considered, rather than a true structural change.

Industry 26 (agricultural implements and steel products not elsewhere classified) also shows an improvement in its D_j index. Here it is difficult to offer a single explanation. Besides the fact that this industry is fairly highly aggregated in both the 1949 and the 1961 tables it also happens that the construction of its price index is based on a linear projection of the 1959 (1949 = 100) price index [1] and should not therefore be taken at its face value.

The explanation for industry 31's (products of petroleum and coal) improved index follows along the same lines as that given for the improvement of its u_j index. The same applies for industries 9 (fish processing), 8 (dairy products) and 23 (paper products). Industry 28 (jewellery and miscellaneous manufacturing industries) is again a highly aggregated industry making any single explanation very weak.

The industries now that show the greatest relative deterioration in their D_j index are the following:

36	10	33	16	37	35	12	24	18
(0.32)	(0.15)	(0.14)	(0.10)	(0.10)	(0.09)	(0.09)	(0.07)	(0.06)

The numbers in brackets indicate the magnitude of the difference of the two D_j indexes for each sector between the years 1949 and 1961.

The industries showing the greatest negative difference is industry 36 (electricity, water and gas uilities). The

[1] See Appendix A.

decrease in the D_j index of that industry agrees with the decrease in its u_j index discussed earlier and could be due to the same reasons. Here again the high aggregation of this industry makes it difficult to determine the main cause of the deterioration.

Industry 10 (fruit and vegetable preparation) is the next in line as far as decreases in the D_j index go. This industry had also shown a decrease in its u_j index and the decline seemed to have been the result of changes in tastes. Similarly the deterioration of the D_j index for industries 33 (construction), 16 (tobacco and tobacco products), 37 (finance insurance and real estate), 35 (communication), 12 (bakery products) and 24 (printing and publishing), is in agreement with the deterioration of the u_j index for these industries. Only industry 18 (leather products) shows a decline in its D_j index while its u_j index had improved over the time period 1949-1961. This discrepancy in the movement of the two indexes is relatively small (a 3.8% increase in its u_j index and a 5.1% decrease in its D_j index), however, and could be the result of errors in computation or industry definition.

This comparison of the D_j indexes of industries for the two periods has brought forth a fact worth noting. This is the observation that in every industry examined, the change in its D_j index, whether positive or negative was in the same direction with the change in its u_j index. These were the industries that showed a high relative change over the period

1949-1961 and this change could therefore not be attributed to computational errors alone. The changes in the rest of the industries were small enough to be very well caused by such errors.

This agreement in the direction of the movement of the two indexes u_j and D_j should be expected in most cases. The increase, for example, of the u_j index of an industry means an increase in some or all intermediate inputs into that industry. These inputs are provided by other industries which in turn could have increased their intermediate inputs and therefore their u_j index. These secondary increases are now reflected in the D_j index of the first industry. Even if secondary increases do not take place, because no change had occurred, e.g., in the structure of the industries supplying the inputs for the first industry, still the D_j index of that first industry will increase reflecting in this case the increases in intermediate inputs of only the first industry. Only if some or all of the supplier industries have decreased their intermediate inputs by a bigger proportion than the increase of the intermediate inputs taken by the first industry, the D_j index of that first industry could have been decreased where its u_j index has been increased. But as the present results show, this is rather the exceptional case, the general rule being that the two indexes move in the same direction.

If we now proceed to compare the indexes of sensitivity of dispersion S_i for the two years we observe that the

industries which show a noticeable relative improvement on the basis of this index are:

30	9	36	3	5	32	1	4	38
(0.00)	(0.01)	(0.05)	(0.07)	(0.17)	(0.24)	(0.31)	(0.48)	(2.02)

where the numbers in brackets indicate the difference between S_i in the 1949 and S_i in 1961.

The industry that shows the greatest improvement by far, compared to the other eight industries is industry 38 (service industries). This same industry had also shown a fairly greater improvement in its w_i index as we recall from the earlier comparison of this index. The increase in its S_i index confirms the importance that this industry has as a basis for further development.

We recall that the w_i index of an industry reflects the magnitude of the connection that this industry has with its customer industries. But as the u_j index reflects only the connection that an industry has with its suppliers industries and does not take into consideration intermediate inputs to the suppliers industries, the w_i index reflects only the connection of an industry with its customer industries and is not affected by the amount of inputs of other industries from the customers of the first industry. This is only reflected in the S_i index and in the case of the service industry indicates this additional influence that "services" have on industries other than its direct customers which in this case and on the basis of the criterion used, is fairly substantial.

It is a pity that the degree of aggregation is so high in such an important industry. A breakdown would most certainly improve our knowledge as to which of the sub-industries show the strongest linkage effects and which are those that show the largest improvement over the years.

The industry which is next in line, as far as the improvement of its S_i index goes, is industry 4 (metal mining, smelting and refining). Here again, it is hard to trace the causes of the improvement because of the same reasons that made it difficult to explain the changes in the u_j, D_j index of this industry.

The S_i indexes of industries 1 (agriculture) and 32 (chemicals) also move in the same direction as the w_i index of these industries and most likely for the same reasons.

Of the remaining five industries only industry 5 (coal mining, crude petroleum and natural gas) shows a noticeable difference in the index and the direction of change is the opposite of the w_i index of that industry the w_i index showing a decline in 1961.

This result emphasizes the point made earlier that even when the crude index (u_j or w_i) of an industry is small or shows a decline, the industry may still be important because of the secondary repercussions its expansions may have on a wider segment of the national industrial system instead of just on the industries directly connected with it. The reason for an increase in the S_i index here in spite of the decrease in the w_i index is most likely due to the fact

that industry 5 supplies a smaller proportion of its output as intermediate inputs to other sectors but it happens that the customer sectors are themselves greater suppliers of intermediate inputs to other industries. On this basis industry 5 does not decline in importance as the decrease in its w_i would suggest.

Looking now at those industries that show the greatest relative decrease in their S_i index we see that these are industries

26	37	31	33	34	27	35	22	18
(0.37)	(0.37)	(0.27)	(0.27)	(0.26)	(0.22)	(0.21)	(0.17)	(0.12)

Industry 26 (agricultural implements and steel products n.e.c.) shows the greatest decrease. Any single explanation as to why this happened would be misleading because of the reasons already given in the examination of the D_j index of that industry. That is mainly because of the high degree of aggregation in that industry. Industries 37 (finance insurance and real estate), 31 (products of petroleum and coal), 33 (construction), 34 (transportation storage and trade), 27 (transportation equipment), 22 (wood products), 18 (leather products) all show a parallel decrease in their w_i index and the reasons were given there for such a deterioration. Sector 35 (communication) however although within the group of industries with declining S_i indexes showed an increase in the value of its w_i index. This means that the customer industries to industry 35 are not of the kind that have increased their sales of intermediate inputs to other

industries. In fact it seems they have decreased them, since only such decreases could cancel out the increase in sales from the first industry to its customers shown by the increase in its w_i index.

Table 5.9 shows the indexes of variance V_j for each industry for the two years. It appears by looking at the table that, in general, the individual industries draw rather uniformly on the national industrial system and that this uniformity is maintained in both years. This is witnessed by the fact that the individual V_j values are close to the average values for these indexes in the two years. These average values are $V_j = 4.09$ for 1949 and $V_j = 3.69$ in 1961.[1] A comparison of these individual indexes for the two periods does not show any significant changes. In no industry does the change of its V_j index exceed 20% (or 1.7% per year). The change in the average value of this index between 1949 and 1961 is only 9.7% (i.e. the change from $V_j = 4.09$ to $V_j = 3.69$).

Similarly if we examine the V_i indexes, also shown in table 5.9, we observe that the products of the individual industries are distributed fairly evenly as intermediate inputs to other industries. This is judged to be so by the fact that the individual V_i values are close to the average values for this index in each year. The average values

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[1] These are simple averages of the V_j values calculated from columns 1 and 2 of Table 5.9.

this case $V_i = 4.56$ for 1949 and $V_i = 4.33$ in 1961.[1]

Here again, a comparison of the individual indexes for the two years does not show significant changes. The change in the average V_i value during the period 1949-1961 is even smaller than that for the V_j index. In this case (of the V_i index) the change is only 4.8% (or 0.4% per year).

Such small changes, as they are observed for the V_j, V_i indexes, could have been caused by any of several sources of errors such as faulty price index estimations, excessive aggregations, drastic redefinition of industries etc. It is,therefore, rather dangerous to make generalizations with regard to an increase or a reduction in the evenness with which the various industries draw from or sell to each other their intermediate inputs.

If there is something that can be said on the basis of the results of the examination of the V_j, V_i indexes, it is that the Canadian economy shows a trend towards more such evenness or uniformity. The reason for such a trend is not hard to imagine. Intermediate inputs are themselves a collection of various components. It is possible that a group of such components was produced in the past by one industry alone. Thus the purchase of this group of intermediate components would then simply increase the magnitude of this input coefficient by the user industry. This industry would then be drawing one sidedly from the producing industry and

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[1] These averages are calculated from columns 3 and 4 of Table 5.9.

therefore its V_j index would in this case show a high value indicating an uneven drawing of inputs, by the user industry, from the industrial system as a whole. Suppose now that the group of components is no longer produced by one industry alone but because of increasing specialization in the economy, it is now produced by several industries each specializing in one of the components. In this case when the user industry buys the same group of components as before the purchase will be recorded as a number of input coefficients instead of just one as was previously the case. Thus the purchases of the user industry are spread more widely and more evenly throughout the economy resulting in a decrease in the value of its V_j index.

The decrease in the V_i index of industries, which is the second course of the augmented evenness in the economy, could similarly be explained by an increase in specialization but this time on the side of sales of the intermediate inputs producing industry.

We now wish to see which of the 38 industries can be characterized as Rasmussen's "Key Industries." As was the case with Chapter III, this is done by classifying industries according to the values of their D_j and V_j indexes. This classification is shown in Tables 5.10 and 5.11. Of the four categories of industries in these two tables, category 1 is the one that satisfies the definition of "Key Industries." This group contains industries whose D_j values are above the average D_j value for all sectors, and whose V_j values are

below the average V_j value for all sectors.

Category IV includes industries that are the direct opposite of those in category 1. That is, not only do they draw the least from other sectors, they also draw one-sidedly for the limited inputs they buy from other industries.

A comparison of the "Key Industries," as defined by Rasmussen, based on tables 5.10 and 5.11 reveals no significant differences in the values of their D_j and V_j indexes. Furthermore 13 out of 16 industries in this group are present in both 1949 and 1961. This suggests that industries that were found to be "Key Industries" for Canada in 1949 remained as such through 1961.

It may now be asked whether some industries have, over the years, become more "key" than others, while others have become less important.

One way of answering this question is to take a simple average of the D_j, V_j indexes in the "Key Industry" group (Group 1 of tables 5.10 and 5.11) and observe which of the industries in this group have D_j's greater than the group average and which have a V_j index smaller than the average V_j for the group. These would be industries that could be considered to be more "Key" than others within the "Key Industry" group. Having done this for the two years we could then observe whether or not some industries have been promoted to the above average position in the later years or whether or not some industries have dropped out of such a position which they held in 1949.

TABLE 5.10

TYPE OF INDUSTRIES IN CANADA 1949
WITH RESPECT TO D_j,V_j

	Low V_j (<4.09)				High V_j (>4.09)			
	1		D_j	V_j	II		D_j	V_j
	7	Meat Production	1.23	3.48				
	8	Dairy Production	1.14	3.57	36	Electricity Water & Gas Utilities	1.04	4.47
	9	Fish Processing	1.02	3.75				
	10	Fruit & Vegetables	1.29	3.03				
	11	Grain Mill Products	1.33	3.25				
High D_j (<1.00)	12	Bakery Products	1.21	3.14				
	14	Alcoholic Beverages	1.02	3.76				
	16	Tobacco & Products	1.40	3.40				
	18	Leather Products	1.17	4.04				
	20	Clothing	1.02	3.92				
	22	Wood Products	1.10	3.69				
	23	Paper Products	.98	3.34				
	24	Printing & Publishing	1.02	4.07				
	27	Transportation Equipment	1.00	4.07				
	32	Chemicals & Allied Products	1.03	3.96				
	33	Construction	1.14	3.40				

(Table 5.10 Continued)

	Low V_j (<4.09)			High V_j (>4.09)		
	III	D_j	V_j	IV	D_j	V_j
Low D_j (< 1.00)	1 Agriculture	1.00	3.81	2 Forestry	.80	4.69
	13 Carbonated Beverages	.98	4.07	3 Fishing & Hunting	.80	4.71
	21 Furniture	.98	3.88	4 Metal Mining & Smelting	.85	4.55
				5 Coal Mining Petroleum & Gas	.79	4.75
				6 Non-Metal Mining	.85	4.38
				15 Confectionery & Sugar Refining	.88	4.51
				17 Rubber Products	.89	4.24
				19 Textile Products	.97	4.81
				25 Primary Iron & Steel	.94	4.40
				26 Agricultural Implements & Steel Products n.e.c.	.98	4.18
				28 Miscellaneous Manufacturing Industries	.92	4.28
				29 Electrical Apparatus & Supplies	.97	4.12
				30 Non-Metallic Mineral Prod.	.95	4.13
				31 Products of Petroleum & Coal	.91	4.37
				34 Transportation Storage & Trade	.88	4.55
				35 Communication	.82	5.05
				37 Finance, Insurance & Real Estate	.84	4.97
				38 Service Industries	.84	4.63

Note: The values for D_j and V_j are taken from Tables 5.8 and 5.9.

TABLE 5.11

TYPES OF INDUSTRIES IN CANADA 1961
WITH RESPECT TO D_j, V_j

	Low V_j (<3.69)			High V_j (>3.69)		
	I	D_j	V_j	II	D_j	V_j
High D_j (>1.00)	7 Meat Products	1.28	3.28	4 Metal Mining & Smelting	1.01	4.85
	8 Dairy Products	1.22	3.23	27 Transport Equipment	1.01	4.04
	9 Fish Processing	1.11	3.18	32 Chemicals & Allied Prod.	1.03	3.76
	10 Fruit & Vegetable Preparations	1.14	3.05	38 Service Industries	1.08	3.72
	11 Grain Mill Products	1.29	3.05			
	12 Bakery Products	1.12	2.97			
	14 Alcoholic Beverages	1.00	3.44			
	16 Tobacco & Products	1.30	3.41			
	18 Leather Products	1.11	3.60			
	20 Clothing	1.00	3.68			
	22 Wood Products	1.13	3.41			
	23 Paper Products	1.05	3.65			
	25 Primary Iron & Steel	.99	3.57			
	26 Agricultural Implements & Steel Products n.e.c.	1.02	3.71			
	31 Products of Petroleum & Coal	1.00	3.50			
	33 Construction	1.00	3.36			

(Table 5.11 - Continued)

	Low V_j (<3.69)	High V_j (>3.69)
Low D_j (<1.00)	III 17 Rubber Products .94 3.62 21 Furniture .99 3.39 28 Miscellaneous Manufacturing Industries .98 3.46	IV 1 Agriculture 2 Forestry 3 Fishing & Hunting 5 Coal Mining, Crude Petroleum & Gas 6 Non-Metal Mining 13 Carbonated Bev. 15 Confectionery & Sugar 19 Textile Products 24 Printing & Publishing 29 Electrical Apparatus & Supplies 30 Non-Metalic Mineral Prod. 34 Transportation & Storage & Trade 35 Communication 36 Electricity, Water & Gas, Utilities 37 Finance, Insurance & Real Estate

Note: The values for D_j and V_j for 1961 are taken from Tables 5.8 and 5.9.

TABLE 5.12

TYPE OF KEY INDUSTRIES HAVING A D_j INDEX

GREATER THAN ONE AND A V_j INDEX SMALLER THAN THE

AVERAGE OF GROUP I OF TABLES 5.10 and 5.11

1949 Average V_j = 3.62			1961 Average V_j = 3.38		
	D_j	V_j		D_j	V_j
7 Meat Products	1.23	3.48	7 Meat Products	1.28	3.28
8 Dairy Products	1.14	3.57	8 Dairy Products	1.22	3.23
10 Fruit & Vegetable Preparations	1.29	3.03	10 Fruit & Vegetable Preparations	1.14	3.05
11 Grain Mill Products	1.33	3.25	11 Grain Mill Products	1.29	3.05
12 Bakery Products	1.21	3.14	12 Bakery Products	1.12	2.97
16 Tobacco & Products	1.40	3.40			
33 Construction	1.14	3.40			

Note: The values for D_j and V_j are taken from Tables 5.10 and 5.12

This new classification of industries is shown in table 5.12. An examination of table 5.12 shows that no industry has become more "Key" than it already was in 1949 while two industries have declined from their above average position held by them in the earlier year. These are industries 16 (tobacco and products) and 33 (construction).

Although the "tobacco and products" industry still has an above average D_j index, its V_j value has dropped showing that the industry draws its inputs from fewer industries than it did before. The V_j value is still close to the group average, however, and a rationalization of the change could be misleading. The "construction" industry on the other hand shows a drop in its D_j index only. The reason for the change was given when this index was analyzed and it was then attributed to a greater efficiency of space utilization.

It is interesting to note that the average D_j and V_j values for the "Key Industries" group as a whole (group 1) have hardly changed. This means that the "Key Industries" as a whole have become neither more nor less "Key" in the Rasmussen terminology than they were before.

Firstly "Key Industries" are highly aggregated. Had there been a more detailed breakdown of the input-output tables we could probably observe larger changes in linkage characteristics since we would then be observing such characteristics of more narrowly and specifically defined industries.

The introduction of the fuel injection system in the motor car industry, for example, is an important innovation and may change the a_{ij} coefficient of the motor car industry. This industry, however, is only one of many that are grouped together in the larger "transportation equipment" industry which is recorded in the input-output tables. This being the case, the change in the a_{ij} coefficient of the automobile industry will cause a much smaller change in the a_{ij} coefficient of the transportation equipment industry. The magnitude of the change depends on how big the automobile sub-industry is compared to the other sub-industries within the larger group.

A second reason for the stability of "Key Industries" is that their scale of production is likely to be already large enough at the point at which the time comparison begins so that variations in the scale of production are not likely to be great over the period of time examined. A stamping operation in the "transportation equipment industry" for example will have to be fairly large from the start; otherwise the industry will not be operating at the optimum point. Any changes in the scale of such an operation are therefore likely to be small compared to the initial size. This relatively small change in the scale of production implies a small change in the a_{ij} coefficient of the industry.

If there was an increase in the scale of production it would most likely result in an increase in economies of scale which would mean that either a greater volume of output

is being produced from the same amount of inputs or that the same volume of output is produced by a smaller amount of inputs. In either case the ratios of the various inputs to the total output of an industry would decrease which means that its a_{ij} coefficients would decrease.

With minute changes in the scale of production there will be only minute changes in the a_{ij} coefficients which is then reflected in a lack of change in the linkage characteristics and hence make for the greater stability of the industry in question.

In contrast to these stable "Key Industries" one can consider the changes that could occur in an industry such as agriculture for example. The change in the scale of operation alone is likely to make for a considerable change in the indexes of that industry. Particularly the indexes that reflect the "backward" linkage of that industry. To the extent that this industry is becoming more efficient, one would expect a decrease in its u_j and D_j indexes.

Finally another reason making for the greater stability of the "Key Industries" could be that these industries, being part of the manufacturing industries, are subject to more accurate statistical estimations of the values of their inputs and outputs. Thus changes in such data reflect changes in the structure of the industry. In cases where such data do not exist originally, estimations have to be made which could result in errors which in turn would cause the indexes of an industry to show greater variations over time.

The "Key Industries" as have been defined and examined so far, refer only to those that draw heavily from the industrial system for their inputs, but this definition excludes sectors that have relatively high values of S_i. That is, this definition includes only the "backward linkage" notion of an industry.

By changing the definition of a "Key Industry" slightly we could have a list of industries that would reflect the "forward linkage" notion. Such industries could be called "Forward Key Industries" and would be characterized by relatively high S_i values and relatively low V_i values.

Group 1 of tables 5.13 and 5.14 is a list of such industries.

A comparison of these industries for the two periods examined reveals no significant differences in the S_i, V_i values of the industries included. Furthermore, the majority of the industries in the group appear in it in both years.

In both years the sectors of "agriculture" (no. 1) and that of "transportation, storage and trade" (no. 34) appear to be the most characteristic "Key Industries" in the "forward linkage" sense. And of the two, that of transportation has the highest S_i value.

This could be taken as an empirical backing of the argument that the existence of infrastructures, such as those of industry 34 are conducive to the establishment of higher industries (i.e. secondary and tertiary industries).

Finally these industries that have both high D_j and

TABLE 5.13

TYPE OF INDUSTRIES IN CANADA 1949

WITH RESPECT TO S_i,V_i

	Low V_i (<4.56)			High V_i (>4.56)		
	I	S_i	V_i	II	S_i	V_i
High S_i (>1.00)	1 Agriculture	1.95	2.39			
	2 Forestry	1.00	3.86			
	19 Textile Products	1.18	4.09			
	23 Paper Products	1.39	3.07			
	26 Agricultural Implements	1.69	2.42			
	27 Transport Equipment	1.01	4.00			
	31 Products of Petroleum & Coal	1.22	3.18			
	32 Chemicals	1.01	4.04			
	33 Construction	1.29	2.92			
	34 Transportation, Storage & Trade	2.99	1.29			
	35 Communic	1.01	3.95			
	36 Electricity, Water & Gas	1.04	4.44			
	37 Finance & Insurance	1.85	2.18			
	38 Service Industries	1.34	2.85			

(Table 5.13 - Continued)

	Low V_i (<4.56)			High V_i (>4.56)		
	III	S_i	V_i			
Low S_i (<1.00)	11 Grain Mill Products	1.00	4.22	3 Fishing, Hunting & Trapping	.75	5.30
	22 Wood Products	.97	4.39	4 Metal Mining & Smelting	.73	5.13
	25 Primary Iron & Steel	.94	4.41	5 Coal Mining	.78	4.83
				6 Non-Metal Mining	.68	5.86
				7 Meat Products	.66	4.99
				8 Dairy Products	.77	5.85
				9 Fish Processing	.63	4.91
				10 Fruit & Vegetable Preparations	.63	6.12
				12 Bakery Products	.61	6.15
				13 Carbonated Beverages	.65	6.16
				14 Alcoholic Beverages	.63	6.11
				15 Sugar Refining	.80	4.99
				16 Tobacco & Products	.80	6.16
				17 Rubber Products	.74	5.12
				18 Leather Products	.78	6.05
				20 Clothing	.64	6.02
				21 Furniture	.64	5.92
				24 Printing & Publishing	.94	4.83
				28 Miscellaneous Manufacturing Industries	.70	5.61
				29 Electrical Apparatus & Supplies	.83	4.75
				30 Non-Metallic Mineral Products	.77	5.07

Note: The values of S_i and V_i indexes are taken from Tables 5.8 and 5.9.

TABLE 5.14

TYPE OF INDUSTRIES IN CANADA 1961

WITH RESPECT TO S_i, V_i

	Low V_i (<4.33)			High V_i (>4.33)		
	I	S_i	V_i	II	S_i	V_i
High S_i (>1.00)	1 Agriculture	2.26	2.04			
	2 Forestry	1.07	3.56			
	4 Metal Mining	1.21	4.07			
	19 Textile Products	1.08	3.91			
	23 Paper Products	1.32	2.86			
	26 Agriculture Implements	1.69	2.80			
	32 Chemicials	1.25	3.02			
	33 Construction	1.02	3.21			
	34 Transportation Storage & Trade	2.73	1.23			
	36 Electricity, Water & Gas	1.09	3.67			
	37 Finance & Insurance	1.48	2.32			
	38 Service Industries	3.36	1.11			

(Table 5.14 - Continued)

	Low V_i (<4.33)			High V_i (>4.33)		
	III	S_i	V_i	IV	S_i	V_i
Low S_i (<1.00)	5 Coal Mining	.95	3.66	3 Fishing, Hunting & Trapping	.64	5.24
	11 Grain Mill Products	.98	4.17	6 Non-Metal Mining	.60	5.48
	24 Printing & Publishing	.84	4.22	7 Meat Products	.80	4.69
	25 Primary Iron & Steel	.85	4.09	8 Dairy Products	.65	5.40
	31 Products of Petroleum & Coal	.95	3.48	9 Fish Processing	.78	4.52
	35 Communication	.83		10 Fruit & Vegetables	.60	5.78
				12 Bakery Products	.56	5.86
				13 Carbonated Beverages	.61	6.05
				14 Alcoholic Beverages	.58	5.95
				15 Sugar Refining	.69	5.14
				16 Tobacco & Products	.69	6.16
				17 Rubber Products	.67	5.06
				18 Leather Products	.66	6.03
				20 Clothing	.61	5.86
				21 Furniture	.57	5.99
				22 Wood Products	.85	4.61
				27 Transport Equipment	.79	5.17
				28 Miscellaneous Industries	.68	4.95
				29 Electrical Apparatus	.76	4.87
				30 Non-Metallic Mineral Products	.77	4.69

Note: The values of the S_i and V_i index are taken from Tables 5.8 and 5.9.

TABLE 5.15

KEY INDUSTRIES WITH RESPECT TO BOTH

D_j, V_j and S_i, V_i

1949			1961		
$D_j > 1.00$, $V_j < 4.09$ $S_i > 1.00$, $V_i < 4.56$			$D_j > 1.00$, $V_j < 3.69$ $S_i > 1.00$, $V_i < 4.33$		
Industry	D_j	S_i	Industry	D_j	S_i
1. Agriculture	1.00	1.95	1. Agriculture	.95	2.26
23. Paper Products	.98	1.39	23. Paper Products	1.05	1.32
26. Agricultural Implements & Steel Products n.e.c.	.98	1.69	26. Agricultural Implements & Steel Products n.e.c.	1.02	2.80
27. Transportation Equipment	1.00	1.01	32. Chemicals & Allied Products	1.03	1.25
32. Chemicals & Allied Products	1.03	1.01	33. Construction	1.00	1.02
33. Construction	1.14	1.29			

Note: This table is based on the data from Tables 5.8 and 5.9.

TABLE 5.16

COMPARISON OF INDUSTRIES HAVING RELATIVELY HIGH D_j, S_i INDEXES

AND THOSE HAVING RELATIVELY HIGH u_j, w_i INDEXES

1949

$U_j > 40$, $w_i > 41$				$D_j > 1.00$, $S_i > 1.00$			
	Industry	u_j	w_i		Industry	D_j	S_i
1	Agriculture	43	48	1	Agriculture	1.00	1.95
11	Grain Mill Products	72	59	11	Grain Mill Products	1.33	1.00
22	Wood Products	56	63	22	Wood Products	1.10	.97
24	Printing and Publishing	43	77	24	Printing and Publishing	1.02	.94
32	Chemicals	44	53	27	Transportation Equipment	1.00	1.01
36	Electricity, Water & Gas	42	68				
				32	Chemicals & Products	1.03	1.01
				33	Construction	1.14	1.29
				36	Electricity, Water & Gas	1.04	1.04

Note: Data from Tables 5.3 and 5.8

TABLE 5.17

COMPARISON OF INDUSTRIES HAVING RELATIVELY HIGH D_j, S_i INDEXES AND THOSE HAVING RELATIVELY HIGH u_j, w_i INDEXES

1961

$u_j > 47$, $w_i > 45$			$D_j > 1.00$, $S_i > 1.00$		
Industry	u_j	w_i	Industry	D_j	S_i
11 Grain Mill Products	78	69	11 Grain Mill Products	1.29	.98
22 Wood Products	60	59	22 Wood Products	1.13	.95
26 Agricultural Implements	49	62	23 Paper Products	1.05	1.32
31 Products of Petroluem & Coal	53	58	26 Agricultural Implements	1.02	2.80
32 Chemicals	50	61	31 Products of Petroleum & Coal	1.00	.95
38 Service Industries	57	64	32 Chemicals	1.03	1.25
			33 Construction	1.00	1.02
			38 Service Industries	1.08	3.36

Note: Data from Tables 5.4 and 5.8.

S_i values while showing low V_j and V_i values are shown in table 5.15. In this case too, the sectors that are in the group in 1949 are also in the group in 1961.

If we now consider only the industries that have high D_j and S_i values, we will have a group of industries that can be compared with the "intermediate manufacturing" group of tables 5.3 and 5.4, a group that has relatively high values of the u_j and w_i indexes. Table 5.16 compares the industries classified on the basis of D_j, S_i indexes and those classified on the basis of u_j and w_i for 1949. Table 5.17 does the same for 1961.

It can be seen from the last two tables that industries shown to have relatively strong backward and forward linkages when measured by the u_j, w_i indexes have also relatively high D_j S_i indexes. This similarity is apparent in both years.

2. The "Gamma" Index

The next step in this chapter is to examine what type of industries have undergone the smallest change in their production structure within the period considered. The appropriate measure for showing such a change is the "gamma" index (γ_j) described in Chapter II and used also in the case of international comparisons. This index is slightly modified here as

$$\gamma_j = \frac{\sum_i |a^*_{ij} - a_{ij}|}{1/2 \sum_i (a^*_{ij} - a_{ij})}$$

where a_{ij} is the ijth element of matrix A referring to the matrix of the coefficients in the base (1961) year and a^*_{ij} is the ijth element of matrix A which is the matrix of the coefficients in the current (1949) year as recalculated in terms of base year prices.

As was explained in Chapter II, the smaller is the value of this index for a particular industry the less the structural change in that industry. If there is no change at all, it will be recalled, the index takes the value of zero. In the opposite case its value is equal to 2.0.

The results of the comparisons are shown in table 5.18.

In table 5.19 all the two periods comparisons have been classified by the magnitude of the gamma index and by type of industry. Two main categories constitute the type of industry. The one containing the "Key Industries" and the other including all the industries not classified as such. Here the term "Key" is with respect only to the values of D_j and V_j.

The table indicates that the so-called "Key Industries" show relatively fewer changes in their production structures compared to the other industries. Eleven out of a total of twenty "Key Industries" or 55% show a "gamma" index of .499 or less as against 3 out of a total of 18 or 16.6% for the other industries. Only one of the 20 key industries shows a "gamma" index greater than 1 out of a maximum of two. This is the industry of "primary iron and steel"

(industry 25). It is to be expected that the technology in such an industry is more likely to show greater changes than say the technology in the meat products industry which is also one of the "Key Industries." It may be pointed out that the sector of primary iron and steel shows a decrease in its V_j index although too much emphasis must not be put on the change of that index because of the reservations discussed earlier. The change, however, does hint that the technology in this industry has changed in such a way as to make the industry draw its inputs from the other industries more evenly than in 1949.

The results of this analysis, based on the γ_j index, strongly confirm the conclusion reached earlier concerning the relative stability of the "Key Industries." It must be emphasized again that the results in both analysis apply only to those industries whose categorization as "Key Industries" is based only on the values of their D_j, V_j indexes.

In the case where the term "Key Industry" is taken to mean the industries with relatively high values of S_i and relatively low values of V_i a different classification results which is shown in table 5.20.

On the basis of this table (table 20), 6 out of a total of 15 "Key Industries" or 40% show column differences of 0.499 or less as against 9 out of a total of 23 or 39.13% for the other industries. 33.3% of the "Key" show differences between 0.500 and 0.799 as against 47.8% for the other

industries.

It is apparent from these figures that industries classified as "Key Industries" with respect to the "forward linkage," do show approximately the same degree of structural change compared to the non-key ones.

These are exactly the type of "Key Industries" where, as was explained earlier, structural changes should be expected because of one or all of the reasons given them. Statistical data for agriculture are most likely to have undergone drastic changes and improvement causing errors in the measurement of changes in the industry because, among other things, of changes in the definition of the variables involved. Changes in the scale of production in industries such as "agriculture" are also likely to have been substantial bringing with them an increase in efficiency and so altering the indexes of these industries.

The same type of investigation of column differences for the case of those industries that show relatively high values for both D_j and S_i indexes yields the results shown in table 5.21. These are the industries that are classed as "Intermediate Manufactures."

The data in this table show all of the industries with high D_j and S_i values have "gamma" indexes ranging from 0.00 to 0.799 as against 78.12% for the other industries. This category of industries, therefore, does show more stability in their production structure compared to the other industries. This stability, however, is not as pronounced

TABLE 5.18

THE "GAMMA" INDEX OF CANADIAN INDUSTRIES

	Industry	γ_j
1	Agriculture	.504
2	Forestry	1.341
3	Fishing Hunting & Trapping	.606
4	Metal Mining	1.354
5	Coal Mining	1.121
6	Non-Metal Mining	.886
7	Meat Products	.448
8	Dairy Products	.476
9	Fish Processing	.676
10	Fruit & Vegetable Preparations	.465
11	Grain Mill Products	.544
12	Bakery Products	.437
13	Carbonated Beverages	.615
14	Alcoholic Beverages	.771
15	Sugar Refining	.533
16	Tobacco & Products	.215
17	Rubber Products	.683
18	Leather Products	.555
19	Textile Products	.353
20	Clothing	.460
21	Furniture	.397
22	Wood Products	.410
23	Paper Products	.405
24	Printing & Publishing	.386
25	Primary Iron & Steel	1.028
26	Agricultural Implements	.490
27	Transport Equipment	.665
28	Miscellaneous Industries	.792
29	Electrical Apparatus	.519
30	Non-Metallic Mineral Products	.650
31	Products of Petroleum and Coal	.900
32	Chemicals	.659
33	Construction	.404
34	Transport and Trade	.660
35	Communication	.732
36	Electricity, Water & Gas	.535
37	Finance & Insurance	.463
38	Service Industries	1.012

Note: The index has been calculated according to the equation:

$$\gamma_j = \frac{\sum_i \left| a^*_{ij} - a_{ij} \right|}{1/2 \sum_i (a^*_{ij} - a_{ij})}$$

The nunbering of industries is in accordance with Table 5.1.

TABLE 5.19

THE "GAMMA" INDEX OF "KEY" AND "OTHER" INDUSTRIES

Magnitudes	Key Industries with Respect to D_j, V_j	Other Industries
0.000 - 0.499	11	3
0.500 - 0.799	7	10
0.800 - 0.999	1	1
1.0 +	1	4

Note: Data are from Table 5.19; "Key" Industries include all industries in category I of Tables 5.10 and 5.11.

TABLE 5.20

THE "GAMMA" INDEX OF "KEY" AND "OTHER" INDUSTRIES

Magnitudes	Key Industries with Respect to S_i, V_i	Other Industries
0.000 - 4.999	6	9
0.500 - 0.799	5	11
0.800 - 0.999	1	1
1.0 +	3	2

Note: Data are from Table 5.18; "Key Industries" include all industries in category I of Tables 5.13 and 5.14

TABLE 5.21

THE "GAMMA" INDEX OF "KEY" AND "OTHER" INDUSTRIES

Magnitudes	Key Industries with Respect to D_j, S_i	Other Industries
0.000 - 4.999	3	11
0.500 - 0.799	3	15
0.800 - 0.999	0	1
1.0 +	0	5

Note: Data are from Tables 5.18 and 5.8.

as when "Key Industries" having only high D_j values were compared to the rest of the industries.

Conclusions

The purpose of this chapter was firstly to identify and secondly to examine the constancy of the linkage characteristics of Canadian industries.

In order to reach some conclusions concerning these two goals it was necessary to analyze the changing structure of the Canadian economy in general.In the course of this analysis several other conclusions worth discussing have emerged. One such conclusion is that the Canadian economy shows a trend towards increasing interdependence. This trend was apparent in several stages of the analysis. There was first a general increase in the u_j and w_i indexes in the economy as a whole as witnessed by the increase in the average values of these indexes from 1949 to 1961. Similar increases were observed with respect to the D_j, S_i indexes but, most interestingly, declines were observed in the indexes of variance V_j and V_i indicating that the industries in the economy are now drawing their intermediate inputs more evenly from each other.

There seem to be three main causes for the increase in interdependence: changes in technology; increasing specialization in production that is due to an expanding market rather than changes in technology, and changes in consumer tastes.

Changes in technology may increase the size or the number of sources of the various inputs to an industry, as for example in the case of the aircraft industry where several special metals are required to meet weight and endurance requirements. These metals may come from more than one source thus making this industry dependent on more industries than before. Changes in technology may also increase the size of a particular input of an industry although its total output may have remained the same. The user industry would in this case be more dependent on one of its suppliers than before. An example of such a case is the increase in inputs of research services by the various chemical industries which may be trying to improve the quality of their output in a way that satisfies the requirements of advancement in technology in the industries using the chemical products. In the present study, an industry indicating a fair increase in service inputs (probably research and engineering services) was the forest industry.

Changes in technology, however, also are expected to increase the efficiency of production of an industry, whether this efficiency is expressed in terms of labor productivity, capital productivity or a decrease in raw materials inputs per unit of the industry's output. This increase in efficiency means a decrease in one or more input coefficients in the industry in which technological improvements have occurred. This in turn means a decrease in the dependency of that industry on its suppliers,[1] and in general, a decrease in interdependency among industries.

To the extent that changes in technology cause increase in efficiency, one would expect a decrease in the interdependence of industries in the economy. To the extent,

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[1]It is assumed here that no increases occur in the output of that industry because of a possible drop in the price of its product.

however, that they cause an increase in specialization in inputs one would expect an increase in industrial interdependence.

Increasing specialization in production could not only be caused by changes in technology but also by an expanding market. In this case an industry may take advantage of economies of scale by producing only one component of a particular product and buying others from other industries. Thus an industry producing stereo sets for example, may now decide to specialize in the production of amplifiers only while purchasing the turn tables and speakers from other producers. The outcome is again an increase in the dependency of the stereo sets industry on a greater number of suppliers thus causing a greater interdependence of the economy.

An example of the increase in economic interdependence caused by changes in tastes is the increase in the amount and variety of packaging of various products, mainly foodstuffs, in the market today. Packaging increases the inputs of various industries from the paper products industry, the steel industry, the aluminum industry, etc. Such inputs were either non-existent or of a rather small size in the past.

Still another cause for the increasing interdependence in the economy is the establishment of some new industries or the expansion of others. The increase in fish processing, industry in Canada, for example, made for an increase in inputs from the fishing industry. At the same time these processing industries have also increased their inputs from industries such as agriculture, for vegetable oils, for example, or paper products, steel, aluminum, etc., for packaging.

A second conclusion that came out of the analysis in this chapter is one concerning the similarity of the u_j, D_j indexes on the one hand, and that of the W_i, S_i on the other. It was found that sectors that had relatively high u_j and w_i indexes also had relatively high values for the more comprehensive D_j, S_i indexes. Furthermore the study showed that, with few exceptions, those industries which showed increases in their u_j, w_i indexes over the years, also showed increases in their D_j, S_i indexes. Likewise those industries that showed decreases in the first set of indexes also showed decreases in the other. This is a useful conclusion that can be applied in the identification of important industries. It implies that it is not always necessary to use the more comprehensive and more difficult to calculate set of indexes. The crude ones would in most cases do.

A third conclusion of the analysis is that the industries considered important for further industrial development are industries that are located somewhere between the primary type industries and industries catering to final demand. This is the group of industries that was found to overlap other groups located above or below it in the triangularized input-output matrices. These are also the industries that were found in Group II of tables 5.3 and 5.4 which was termed "intermediate manufacture." Similarly these are the industries found in Group 1 of tables 5.10 and 5.11 which satisfied Rasmussen's idea of a "Key Industry."

The common characteristic of such industries is that they possess the relatively strongest combined linkage effects (backward plus forward). They are, in other words, the industries that are most dependent on others and most depended upon by others in need of intermediate inputs. It is not

difficult therefore to visualize why such industries could be very important industries when an expansion in the national industrial network is required. Their establishment or expansion creates new needs for other products used as inputs to these industries. If these products are not already available pressures will be generated that are likely to eventually break the bottleneck by establishing industries producing them. If these industries are already in existence they will welcome the opportunity to expand offered to them by the establishment of the industry that depends on their products. In a way the process is similar to that of stimulating consumer demands by tax reductions, advertisements, transfer payments or any other means. The increased consumer spending then stimulates the economy through the multiplier. Here, however, the process is not as smooth or as fast. We must remember that when our purpose is to expand the industrial network it means mainly establishment of new industries. For these industries to come in a lot of preparatory work is necessary. The process therefore will be much slower and more uncertain. The incentive is there, however, and once the input requirements of the linked industry approaches the minimum economic size of production of the supplier industry, this supplier industry will find it very attractive to start production in the area or country of the linked industry. It may not even be necessary for the input requirements of the linked industry to be proportional to the output of the supplier. Such supplier industries may have other foreign markets for their outputs but the fact that they could dispose of a substantial part of their output locally, with no headaches of currency devaluation or erection of new tariff walls, could be a strong incentive indeed to locate where its customer industry is.

Similarly the establishment of a strongly linked industry will cause industries dependent upon its product to take advantage of the facility offered. The incentive here may not be as strong as that offered by backward link. There is no bottleneck to be broken, there is only an opportunity to be taken up and it may not be taken up by everybody. There are, however, those who may want to try.

In summary then, and based on the analysis in this chapter, the main characteristic that makes an industry to be a "Key" or in general an important industry is its double role as purchaser and supplier of intermediate inputs. This characteristic gives these types of industries a preference over primary industries which could, as in the case of Canada, be resource industries. These primary or resource industries possess only the much weaker forward linkage effect and could not be expected to bring in the strong incentive needed for a more industrialized economy.

Still another conclusion that has been reached in this chapter is that the "Key Industries" are relatively more stable than non-key industries. This stability has been demonstrated in two ways: firstly, from a comparison of industries based on their D_j, V_j indexes and secondly by observing the magnitude of the γ_j index of all industries. The γ_j index of the "Key Industries" was the smallest compared to that of the other industries. The term "Key" in this case applies only to those industries that have relatively high D_j and relatively low V_j indexes, that is, to those

industries that not only show relatively high backward linkage effect but also distribute these effects fairly even to the industries from which they draw. These industries in other words are those that Rasmussen had in mind. When the term "Key" was extended to include those industries that had relatively high S_i and relatively low V_i, that is to those with strong and evenly distributed "forward" linkage effects, the stability of the "Key Industries" broke down showing these industries to be no more stable than any other industry.

The apparent greater stability of the "Key Industries" could be the result of any one or all of the following factors: a possible smaller relative change in their scale of operation or more uniform way of keeping statistical records. It is very difficult, however, to distinguish which of these factors is the strongest unless and until input-output tables with a finer classification of industries are available. As was pointed out elsewhere in this chapter, excessive aggregation of industries makes for a greater apparent stability of the aggregated industries because of the averaging out of the changes occurring in the sub-industries within the aggregated industry.

CHAPTER VI

SUMMARY AND CONCLUSIONS

The focal point of this study has been the investigation of industrial linkages in the Canadian economy. The study also proposed to examine the stability of these linkages with regard to both space and time.

With regard to space, the Canadian economy has been compared to that of Japan, Norway, the United States and Italy. With regard to time, a comparison of the Canadian economy was made between two different time periods.

In attempting such comparisons the study had to consider the weaknesses inherent in comparing input-output tables of different economies or of the same economy in different time periods.

These tables, although constructed mainly for purposes of empirical implementation, are not entirely comparable in terms of concepts and classifications. For example, in Japan, the activity is the basic accounting unit and production of intermediate products of different activities consumed within the same plant is recorded as an intrasector transaction.[1] In the other four countries, however, intrasector transactions are not distinguished. This

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[1]See H. B. Chenery and T. Watanabe *op. cit.*, p. 491.

difference between Japan and the other countries affects the diagonal elements of the Japanese input-output matrix and makes it less comparable to the others.

Comparability of the two Canadian tables of different time periods is also affected by similar factors. In 1960 for example, there was a substantial revision of the Standard Industrial Classification system at which time many establishments were redefined and reclassified. The effects of these changes are difficult to ascertain. One thing is certain: Such changes will most likely affect the indexes that have been used in this study for the measurements and comparisons of the linkage characteristics.

Comparability of the two Canadian tables in this study is also affected by the quality of the price indexes employed for the deflation of data. Though the outmost care was used in the present work for the construction of the needed indexes, it was impossible to eliminate all possible sources of errors. The series of data used, though fairly complete did not cover all sectors compared. Where data were not available, linear projections of past data were used, thus creating sources of errors.

Taking into consideration these inaccuracies as well as others pointed out in the course of the analysis of results, the following conclusions can be drawn.

1. With regard to the comparison of industrial linkages among countries, it was found that Canada's production structure was fairly similar to those of the other countries

compared.

The fact that Canada is closer to the United States than to the other countries, did not seem to have resulted in a stronger similarity of the production structure of the two countries. Likewise, the fact that Canada has a large export sector relative to its national product did not result in any special similarity of the Canadian economy to that of the countries having also relatively large export sectors.

The main reason for such evenly spread similarities among the countries compared seem to have been the similarity in the technologies employed by these countries.

As was pointed out in Chapter III, this similarity in technology was the main reason for the greater comparability of certain types of industries.[1] Thus the greater comparability of industries having both strong "backward" and strong "forward" linkages was explained by the fact that such industries were more sensitive to technology than to changes in final demand or sources of raw materials.

When patterns of interdependence among sectors were examined it was found that they were also sufficiently similar. Despite large differences in factor endowments, income levels and tastes as well as differences in social characteristics of the countries considered, the similarity in technology seems to have produced the degree of uniformity

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[1]See conclusions of Chapter III, this dissertation.

observed in such pattern.

In examining whether or not the simpler u_j, w_i indexes could be used as substitutes for the more comprehensive D_j and S_i indexes, for the measurement of linkages, it was found that the u_j index is a fairly good substitute for the D_j index. This was not the case however with the w_i index. This latter index overestimates the "forward" effect and could not therefore be used as a substitute of the S_i index without correction.

A general reflection on the results obtained from the intercountry comparison points to the fact that for purposes of development, the "Manufacturing" type industries are more effective. Their relatively high "backward" linkage strengths provide market opportunities which, as was pointed out in Chapter III, are stronger attractive factors than availability of supplies for the establishment of new industries.

2. With regard to the intertemporal comparison of the Canadian economy the main conclusion is that industrial linkages showed a fair degree of stability over the period examined. Patterns of sector interdependence also showed stability, as was revealed by the high values and significance of the rank correlation coefficients.

The sector that showed the greatest stability in linkage effects were again the manufacturing sectors and and in particular those sectors that have the strongest "backward" linkage effects.

Two factors that could mainly be responsible for

the stability of these sectors are (a) the fact that such sectors are likely to undergo a smaller change in their scale of operations relative to other sectors and (b) the fact that these industries are likely to have a more uniform way of keeping statistical records and thus avoid showing changes that are more due to changes in accounting methods than to changes in structural characteristics. An additional conclusion that can be drawn from the intertemporal comparison of the Canadian economy is that, whenever structural changes have been observed, they underline a trend towards a greater interdependence of the Canadian economy.

Although the eleven year period examined in this study may not have been long enough to allow for a fuller development of such a trend, signs of the trend were apparent in several stages of the analysis of Chapter V.[1]

There was firstly a general increase in the values of the u_j and D_j indexes in the economy indicating an increase in the use of intermediate inputs by industries. Secondly and most interestingly, there were declines in the values of the indexes of variance V_j and V_i indicating that the Canadian industries were now drawing their inputs and distributing their outputs more evenly from and to each other.

The reasons most likely to cause such an increase in interdependence were given as (a) changes in technology.

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[1]See conclusions of Chapter V, this dissertation.

Such changes could increase the size or the number of inputs to an industry; (b) increasing specialization in production due to an expanding market. Such specialization could cause an industry to buy inputs that have been previously produced by the industry itself; and (c) changes in consumers' tastes which could force the industry producing the consumers' goods to buy additional inputs from other industries that could be used, for example, to improve the saleability of the main product (Packaging materials e.g.).

The conclusions reached in this study could have been greatly improved if a more detailed classification of industries was used. The high degree of aggregation used for most industries of the input-output tables examined prevented an exact assessment of the changes occurring in the industries aggregated into coarser groups. Thus it is often difficult to specify which of the sub-industries are the ones most responsible in giving the larger sector the linkage characteristics that it has.

This suggests anew the need for the construction of more detailed input-output tables that could make possible a more concentrated study of particular industries and/or aid in determining the reasons behind certain observed trends.

Parallel to this need is the need for a finer and more appropriate series of price indexes, series that will include indexes for each of the industries in such tables. Construction of these series would then permit more accurate

comparisons of the Canadian economy over chosen periods of time and give a better explanation of the reasons for structural changes that may have occurred during these periods.

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APPENDIX A

INDUSTRY AGGREGATION

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INDUSTRY AGGREGATION

In order to make the two types of comparisons of input-output tables prepared in this study, that is the international and the intertemporal, it is necessary to aggregate the 42 original industries in the 1949 Canadian input-output tables into a smaller number of industries so that they match the corresponding industries of the other four countries on the one hand, and the corresponding Canadian industries of the 1961 tables on the other.

In the case of the international comparison the grouping of industries in Canada as well as in the other countries is based on the international standard industrial classification system. The equivalent Canadian classifications were compiled with the help of the Canadian standard classification manual (1951 census edition).[1] The basic tables used for this comparison are the following: Japan (1951, size 182 x 182); Italy (1950, size 200 x 56); Norway (1950, size 117 x 117); the U.S. (1947, size 200 x 200) and Canada (1949, size 42 x 42).[2] The comparable sectors are shown side by side in Table 3.1 of Chapter III.

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[1]Dominion Bureau of Statistics, Standard Industrial Classification Manual 1951 Census Edition (Ottawa: The Queen's Printer, 1951).

[2]See H. B. Chenery and T. Watanabe, *op. cit.*, p. 489.

The basic tables used for the intertemporal comparison are the 1949 Canadian table (size 42 x 42) and one of the three 1961 tables (size 65 x 65). Of the other two 1961 tables, one is excessively aggregated (size 16 x 40) and therefore information will be lost if it was used. The other table of size 110 x 197 was continued in the second volume of the D.B.S. publication on input-output tables which was not yet released at the time at which this dissertation was prepared.[1] The aggregations of corresponding industries of the two tables used were done with the help of two Canadian standard industrial classification manuals.[2] The aggregations used to make the two Canadian tables comparable are shown in Table 5.1 of Chapter V.

There are several statistical and definitional problems that must be considered when comparing various input-output tables whether these tables are of various countries or of the same country but of different time periods. Before we discuss some of them it is useful to consider the basic transacting units in these tables.

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[1]Dominion Bureau of Statistics, The Input-Output Structure of the Canadian Economy 1961, II (Ottawa: The Queen's Printer, 1969).

[2](a) Dominion Bureau of Statistics, Standard Industrial Classification Manual 1951 Census Edition (Ottawa: The Queen's Printer, 1961). (b) Dominion Bureau of Statistics, Standard Industrial Classification Manual (Ottawa: The Queen's Printer, 1960).

An "industry" or "sector" is a collection of individual productive units which are grouped together on the basis of some common characteristic as for example the basic material used (cement products industry); the purpose of the end product (household furniture industry) or the production process employed (metal stamping, pressing and coating industry).

In the case of a firm or enterprise which carries on a variety of activities, there is a problem of dividing the entity into a number of homogeneous units suitable for statistical analysis. To attempt to define each separate production process or activity as the basic unit means, in most cases, adopting a unit which is smaller than that used by firms or enterprises for their accounting records of outputs and related inputs.

The unit used is the "establishment," the smallest unit for which such accounting records are available. Typically, the establishment is the factory, mine, store, service outlet, etc. An industry can be said to be a group of establishments which have sufficient common characteristics that they may be grouped together for analytical purposes.

If an establishment produces two products, for example trucks and agricultural implements, its industrial classifications depends on which of the two products represents the larger share of its gross value of production. If trucks represent the larger share, then the whole establishment is classified to the motor vehicles industry. Each industry usually produces several characteristic or "principal"

products; in many instances they also produce "secondary" commodities which may be principal to other industries (such as agricultural implements in the above example).

The concept of the principal products of industries provides the basis for the link between the input-output industry classification and commodity classification systems. (The two systems are separate in the 1961 tables where the number of commodities differ from the number of industries). In the 1961 standard Industrial classification system, the last three digits in the code numbers for commodities present a numerically sequential listing for those commodities. For a particular commodity, this part of the code number is preceded by the code number of the industry which is the principal producer of the commodity.[1] This code was not used in the 1949 classifications where the number of commodities equaled the number of industries.

As Table 5.1 of Chapter V shows, two classifications were used to define an industry, that of 1948 Standard Industrial Classification systems and the corresponding one of 1960. This double classification was necessary because in 1960 there was a substancial revision of the Canadian industrial classifications. Many establishments, for example, were redefined and/or reclassified. In compiling Table 5.1, particular attentions were paid in placing the reclassified

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[1]Dominion Bureau of Statistics, <u>The Input-Output Structure of the Canadian Economy 1961</u> (Ottawa: The Queen's Printer, 1969), pp. 187-236.

establishments into the correct aggregated sectors. This was not always possible, however, because of loss of information due to change in the definition of an establishment. The effects of such changes are difficult to ascertain. There are other difficulties. In 1949, the smelting and refining operations of certain companies were considered as being an integral part of the mining operation. As a result smelting and refining was defined to be part of the mining industry, and hence, flows of ores from the mines to the smelters were netted out.[1] On the other hand, in 1961 smelting and refining was defined to be a separate manufacturing industry. Although in the process of aggregation, smelting and refining was included again in the mining industry to make it comparable to that of 1949, this inclusion is not a netting out operation and therefore the sector is not exactly the same as that of 1949.

The 1961 interindustry flow matrix that is appropriate for comparison with the 1949 matrix of intermediate input coefficients is the $D(1-\mu)B$ described in Chapter II. In order to approximate the 1940 table with the 1961 information, two assumptions have been made which are embodied in the formula above:

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[1]Dominion Bureau of Statistics, Standard Industrial Classification Manual 1951 Census Edition (Ottawa: The Queen's Printer, 1951).

(1) the imported proportion of a commodity purchased by domestic industries and final purchases (excluding exports) is the same for each purchaser.

(2) each industry or final users purchase a commodity from domestic industries in the proportion that the producing industries supplied the commodity in question.

Neither of these assumptions were strictly adhered to in 1949. In addition, the 1961 estimates of the input-output accounts for Canada are only preliminary, in that some of the estimates have not been reconciled with the revised estimates of the Income and Expenditure Accounts which are being prepared.[1]

The main conceptual differences in the construction of the tables is the case of international comparisons such as treatment of repair and maintenance and other services which were discussed in Chapter III.

These points must be kept in mind when results of the comparisons are being analysed.

For reasons of comparability, the flows in the various input-output tables used in this study are expressed in terms of "producers" prices rather than "purchasers" prices. According to the "producers" price method a consumer who purchases a bar of soap at a retail store is shown as if he

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[1]Dominion Bureau of Statistics, The Input-Output Structure of the Canadian Economy 1961, I, (Ottawa: The Queen's Printer, 1969), p. 9.

paid directly to the manufacturer the manufacturer's selling price for the soap and then paid to the transportation storage, and trade industry the amount of wholesale and retail trade margins, transportation, and other distribution costs. This method, in other words, show a direct link between producer and user and avoids the complications of tracing goods through the table by showing the various distribution channels through which they flow. Thus by excluding transportation and other distribution costs, which could vary considerably among different countries, the use of "producers" prices makes magnitudes of the flows in the input-output tables more comparable. Further, in some applications of input-output analysis the transaction values of commodities are interpreted as proxies for the corresponding quantities. Thus it is desirable that a dollar's worth of a commodity represent approximately the same quantity of that commodity in every part of the tables. This can only be so if "producers" prices are used.

Another problem that must be considered when different input-output tables are compared is the treatment of competitive and non-competitive imports. The distinction is that competitive imports are similar to products produced in some domestic industry, while non-competitive imports (such as coffee or tea in the case of Canada) are not. Since separate information on use of imported and domestic materials in consuming industries is not usually available, it is convenient to allocate the competitive imports first

as an addition to the supply of products from the appropriate domestic industry, and then to redistribute them along with domestic production in that industry's row. Non-competitive imports can be distributed directly to the consuming industries in a single import row.

This is the way Chenery and Watanabe[1] have treated imports in their study, and similarly this is the approach followed in the present study with the exception that all imports are treated as competitive.

Another problem is what to do with unallocated inputs and outputs. Some unallocated figures are inevitable both because of incomplete data and because of inconsistent data sources. The input-output accounting relationships insure that the total value of unallocated outputs in all industries will equal the total value of unallocated inputs, but there is no necessary balance for a single industry. In a solution of the model such as in finding industrial linkages, an industry with a large unallocated input will generate a requirement, via the unallocated row and column for additional production from other industries with large unallocated outputs. In applying the model to estimate linkages it was thought better to eliminate the unallocated figures completely. As was mentioned in Chapter III in order to reduce the conceptual differences, in treating investment, between

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[1]H. B. Chenery and T. Watanabe, "International Comparison of the Structure of Production," Econometrica XXVI (1958), p. 488.

Norway and Italy on the one hand and Japan, Canada and the U.S. on the other, "construction" was treated as part of final demand. That is the construction column was moved to the final demand column, (a summary name which refers to a number of final demand items such as consumer demand, government demand, exports, etc.). The construction row then is moved to the value added section of the table. This is equivalent to saying that each industry does its own construction (i.e. construction is part of the total output of an industry). These transfers to final demand and value added sections of the tables were not necessary in the case of the temporal study since both the 1949 and 1961 tables treat "construction" a separate industry.

<u>Other Adjustments</u>

The industry of "finance, insurance and real estate" which has not corresponding industries in the other four tables has also been eliminated. The "service industries" sector in the Canadian table and in the case of international comparisons has been transferred to final demand since its composition consists mainly of education, health, community public services, etc. What appears in the four other tables as "service industries" is of entirely different composition. It consists of International Standard Industrial Classification designations 513, 521, 384 corresponding to Canadian Standard Industrial Classification 602-609 which includes "electric light and power." Since the non-Canadian

classification does not include this last sector, it was necessary to aggregate the two sectors (electric power and services) in the Chenery-Watanabe tables.

Similarly two other sectors in the Chenergy Watanabe tables, namely sectors 2 (shipbuilding) and 29 (petroleum and natural gas), are not distinguished in the Canadian tables.[1] To make the corresponding industries more comparable required aggregating industries 2 with 9 and 27 with 29 in the Chenery-Watanabe tables. Similar aggregations of industries were necessary in the case of the intertemporal study in order to reconcile the two Canadian tables. These aggregations appear in table 5.1 of Chapter V.

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[1]In the 1949 Canadian input-output tables, industry 2 (shipbuilding) is part of industry 9 (transportation equipment) while industry 29 (petroleum and natural gas) is part of the larger industry 17 (coal ining, petroleum and natural gas).

APPENDIX B

BASIC INPUT-OUTPUT TABLES

AGGREGATED IN A COMPARABLE FORM

INPUT-OUTPUT TABLE FOR THE CANADIAN ECONOMY, 1949

(Column and Row Totals in Millions Dollars)

$a_{ij} \times 10^4$

Producing Sectors \ Using Sectors	1	2	3	4	5	6	7	8	9	10	11	12
1	264	130	0	0	0	5	0	47	33	0	0	0
2	1	2573	0	0	0	2	67	9	50	18	9	0
3	0	436	1094	0	407	0	8	0	0	13	0	0
4	82	0	256	97	0	0	0	0	0	0	0	0
5	0	0	196	0	586	0	0	0	0	0	0	0
6	497	948	1149	410	3441	625	932	680	991	579	815	859
7	74	5	3	215	2	44	288	62	8	4	15	3
8	18	32	40	283	25	246	50	973	91	62	120	73
9	10	70	15	0	0	31	33	248	83	20	149	9
10	3700	70	6	351	120	14	118	73	1833	2927	71	0
11	13	21	17	0	10	33	33	360	66	40	514	94
12	13	196	213	48	28	44	93	1419	158	60	1339	2079
13	0	10	69	29	5	16	8	78	0	4	40	26
14	6	158	21	87	0	61	135	100	0	34	182	78
15	23	32	79	29	215	13	262	97	741	224	122	37
16	37	27	29	0	43	91	50	9	41	16	19	15
17	47	321	3698	0	3905	6	8	2	0	43	0	1
18	0	0	0	0	5	2	0	1	8	2	1	44
19	15	49	113	469	38	133	237	122	200	34	81	409
20	0	0	7	0	0	13	76	160	0	4	597	71
21	0	0	0	0	0	0	93	5	8	0	98	149
22	70	130	253	0	343	87	296	32	116	127	71	40
23	32	43	45	9	56	58	50	54	108	101	58	128
24	3	0	8	0	2	68	8	4	0	16	0	11
Interindustry Total (U_j)	294	96	1589	20	360	702	33	380	54	188	222	405
Total Production (X_j)	592	183	2171	102	390	4384	117	849	120	432	515	967
Imports (Ms)	135	29	229	1	14	110	23	203	32	188	84	143

Producing Sectors \ Using Sectors	13	14	15	16	17	18	19	20	21	22	23	24	Total Intermediate Demand (W_i)	Final Demand	Total Demand
1	0	0	0	0	0	0	0	0	0	0	0	0	25	567.9	593.4
2	0	11	0	0	3	0	0	0	0	9	0	0	54	145.8	200.2
3	15	2	263	0	2	0	0	0	0	4	0	0	274	2019.6	2294.4
4	0	0	0	0	0	0	0	0	0	0	0	0	61	54.2	115.8
5	0	0	4	0	683	0	0	0	0	0	0	0	249	163.5	413.0
6	986	1145	1208	686	480	609	1944	1488	477	759	289	223	1450	2518.2	3969.0
7	5	4	7	6	0	0	7	8	1	3	6	0	39	76.7	117.9
8	191	68	104	18	85	531	107	80	182	125	22	199	295	574.5	870.3
9	20	9	9	6	63	22	67	0	20	3	4	23	73	50.5	124.2
10	50	215	24	0	49	0	0	0	10	89	0	0	440	-90.7	350.3
11	161	39	72	12	17	0	79	44	87	92	136	0	126	433.9	560.7
12	211	183	213	12	170	110	115	112	191	86	49	94	570	483.0	1053.3
13	488	0	123	0	1	0	0	4	41	27	6	0	54	142.6	197.6
14	50	677	106	0	2	132	0	35	134	18	118	0	136	585.2	721.5
15	105	91	1167	172	141	77	63	13	231	126	157	52	210	246.8	457.3
16	20	14	50	862	0	22	31	40	5	21	16	29	93	72.9	166.0
17	25	2735	539	0	301	0	0	0	3	2412	0	0	1501	1269.9	2771.6
18	528	0	75	0	3	0	11	4	24	44	0	0	26	66.6	93.2
19	427	102	438	73	450	254	1002	116	149	151	194	129	374	-120.8	253.8
20	5	29	24	0	4	0	0	1179	0	35	20	0	95	138.7	234.0
21	0	0	75	0	6	44	0	2614	0	5	26	0	84	511.5	596.4
22	236	26	305	2099	7	132	59	35	3	1316	20	0	355	604.3	1019.5
23	281	61	196	56	17	155	127	80	524	246	1911	246	253	103.4	416.9
24	85	1	9	6	0	143	2603	0	36	41	169	52	118	45.3	163.9
Interindustry Total (U_j)	77	386	208	130	660	20	115	130	122	540	152	17			
Total Production (X_j)	198	713	413	324	2686	90	250	223	574	962	482	170			
Imports (Ms)	26	25	105	7	26	0	266	18	45	47	4	0			

Note: Data are based on the 1949 Canadian Input-Output Table, Dominion Bureau of Statistics, Supplement to the Interindustry Flow of Goods and Services, Canada 1949 (Ottawa: Queen's Printer, 1960). The $ Flow figures can be computed by multiplying each element of column n by the element of row 26 and column n and dividing by 10^4.

TABLE B.2

INPUT-OUTPUT TABLE FOR THE JAPANESE ECONOMY, 1951

(Column and Row Totals in 100 Million Yen)

(Table B.2 - Continued)

(Table B.2 - Continued)

$a_{ij} \times 10^4$

Using Sectors / Producing Sectors	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	Total Intermediate Demand (W_i)	Final Demand	Total Demand
1	866	0	1	0	22	52	0	0	0	0	0	0	0	25	1	0	23	3	0	0	8	0	25	0	104	1173	979
2	1	3726	0	0	2	1	3	78	0	18	15	0	0	0	1	0	1	0	0	0	0	0	2	0	192	407	215
3	0	0	774	315	18	3	0	0	0	0	0	0	4	0	167	0	4	0	0	0	0	0	338	0	1145	6781	5036
4	0	0	96	0	0	0	0	0	0	0	0	0	0	0	226	0	0	0	0	0	0	0	34	0	242	1764	1522
5	0	0	963	57	9	0	11	0	0	28	0	0	1	0	21	1	123	0	0	0	0	7	89	0	971	7481	6510
6	304	504	340	222	448	499	381	985	541	206	395	172	581	526	440	417	237	275	733	286	260	490	782	438	3295	15359	12065
7	157	58	5	0	0	25	552	15	0	0	38	1	0	6	0	0	0	0	0	0	0	0	45	0	172	849	677
8	0	0	0	81	0	208	0	1036	0	0	0	0	0	0	0	0	0	0	0	0	0	0	87	0	383	1847	1336
9	65	148	7	147	1	211	14	638	201	6	30	9	48	1	45	28	49	104	32	7	257	42	48	63	482	858	376
10	5668	158	13	811	20	119	443	172	2299	3740	36	7	77	2	40	44	43	33	13	150	23	140	39	17	5049	11404	5755
11	29	2	1	0	0	57	35	2545	1	40	1369	41	3	3	5	53	23	6	0	3	16	3	249	162	1107	3036	2439
12	0	0	135	59	0	361	250	5057	0	6	2767	5511	204	7	63	4	15	607	280	32	828	68	211	1465	8509	11458	2889
13	0	10	95	5	0	23	67	192	0	1	91	81	775	33	73	1	13	24	48	44	17	6	318	21	457	1490	1033
14	5	10	55	61	0	146	229	518	15	10	132	21	198	1239	19	1	9	162	16	11	20	47	212	102	678	1954	1270
15	137	30	204	15	0	53	1051	195	1476	863	107	8	372	120	2361	307	683	124	320	93	357	260	274	171	4276	6107	1831
16	1	0	12	0	0	24	23	2	0	1	2	0	0	0	18	0	0	1	9	3	2	87	181	19	299	1035	736
17	14	3261	1207	29	8705	61	324	0	0	2436	0	16	71	4443	581	13	285	175	0	3	207	635	146	430	11902	10180	4284
18	0	0	4	0	0	5	22	0	13	0	14	11	596	0	53	0	0	0	8	1	1	63	2	0	164	310	152
19	5	9	14	442	0	484	50	147	54	4	46	447	128	4	248	48	15	293	2379	116	57	12	65	120	1479	1793	314
20	1	0	10	7	0	80	536	567	1	1	834	133	45	19	199	22	4	134	3	2845	235	35	339	16	1444	2158	714
21	0	0	0	0	0	0	0	0	0	0	3	255	11	0	106	0	0	0	0	1030	0	0	0	0	571	583	12
22	74	0	138	14	20	233	383	40	32	15	76	4	507	18	452	3561	10	0	27	17	0	3665	20	0	1957	2440	483
23	294	211	157	245	139	1660	925	590	302	369	337	224	355	351	709	1032	210	308	414	290	770	401	1482	1559	5103	14908	9805
24	9	45	101	16	2	2525	105	95	121	62	50	99	1241	22	293	12	0	199	9595	81	34	258	2557	1224	2233	2303	70
Interindustry Total (U_j) 25	916	327	2914	442	6641	6819	399	1545	434	8877	2267	8044	776	1327	3584	568	2159	72	1199	1046	98	1457	4022	485			
Total Production (X_j) 26	1161	397	6583	1749	7035	10180	830	2379	857	11372	3575	11425	1485	1946	5853	1026	12347	281	1666	2082	316	2319	14907	1887			
Imports(M_s)27	12	10	198	15	445	5180	19	151	1	33	61	34	5	8	254	9	3540	34	127	76	207	121	0	416			

Note: Data in this table are based on Table XI of H.B. Chenery and T. Watanabe, op. cit., pp. 508-510.

TABLE B.3

INPUT-OUTPUT TABLE FOR THE ITALIAN ECONOMY 1950

(Column and row totals in 100 Million Lire)

$a_{ij} \times 10^4$

Producing Sectors \ Using Sectors	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	Total Intermediate Demand (W_i)	Final Demand	Total Demand
1	264	0	0	0	0	0	0	0	0	6	0	0	0	1	0	0	0	0	0	0	0	2	2	0	80	2620	2700
2	7	3101	0	0	0	0	9	28	5	0	3	0	0	4	0	13	0	0	0	0	0	3	4	0	567	1216	1783
3	0	1250	393	0	2	2	1	0	11	10	0	3	0	26	289	0	73	17	97	1	0	47	52	0	1506	19841	21347
4	0	0	41	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	84	159	243
5	0	1	1430	0	0	0	0	0	0	2	0	0	0	0	2	0	258	0	0	0	0	0	7	0	3609	3823	7432
6	295	280	392	139	498	498	162	541	277	302	198	194	498	522	328	296	139	31	917	277	103	251	122	158	3186	23202	26388
7	45	55	0	302	0	0	253	498	114	2	136	11	0	215	58	21	0	1	0	16	1	17	0	0	417	3636	4053
8	0	0	0	0	0	0	9	526	5	-0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	194	4308	4502
9	11	38	0	0	0	342	34	330	1171	6	37	1	0	1	1	0	0	0	0	2	0	0	0	0	419	637	1056
10	5504	199	0	1321	0	1	50	112	1184	4358	10	0	12	29	49	78	0	0	1	0	0	450	26	0	6961	5151	12112
11	0	0	0	0	0	0	61	3593	0	0	1491	2	0	5	0	0	0	0	0	5	0	0	0	0	1003	3482	4485
12	2	38	45	0	0	0	2141	4242	101	0	1307	5251	51	24	6	55	0	0	0	209	0	9	0	0	4938	660	5598
13	2	8	4	0	0	10	120	293	0	0	138	101	699	180	52	2	1	0	0	54	0	26	20	0	442	1317	1759
14	1	111	19	0	0	12	112	584	0	1	91	13	0	2499	8	7	1	0	0	27	0	327	0	0	662	873	1535
15	243	483	74	0	0	17	329	265	1774	682	117	161	418	189	3534	491	237	175	252	431	914	1992	130	447	5196	2112	7308
16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	944	944
17	65	12	3957	0	8723	109	29	1	22	1662	1	5	120	3087	235	1	1442	13	16	14	144	534	42	280	21150	9010	30160
18	0	5	32	0	0	0	11	6	22	4	5	45	968	5	182	0	4	0	26	30	0	47	0	0	410	401	811
19	30	22	59	404	8	1518	163	304	449	72	152	439	493	43	263	160	25	125	159	261	103	197	178	377	1984	830	2814
20	2	3	4	0	0	0	877	1103	9	0	618	195	12	10	152	58	0	0	1	2606	0	3	0	0	1292	83	1375
21	0	0	0	0	0	0	0	0	0	0	0	67	3	0	106	0	0	0	0	1275	0	0	0	0	239	41	280
22	2	33	9	0	0	0	13	0	82	7	0	0	358	14	62	3809	0	0	29	0	0	845	0	0	778	255	1033
23	124	185	293	160	290	1104	242	481	221	199	154	402	508	303	774	325	211	68	415	1029	224	497	581	1314	4651	5897	10548
24	6	17	28	0	2	408	30	32	35	45	18	124	726	4	95	6	0	11	6919	44	28	133	323	504	1554	-15	1539
Interindustry Total (U_j) 25	1764	1028	13727	57	7043	2657	1741	2412	505	8692	1766	3563	816	1023	4136	498	6524	33	1197	655	38	530	886	30			
Total Production (X_j) 26	2673	1761	20241	243	7395	2368	3755	4278	922	11816	3947	5080	1676	1428	6678	936	27269	748	2583	1043	249	985	10530	170			
Imports(M_s)27	27	22	1104	1	36	0	298	225	133	296	538	518	82	107	630	8	2590	64	231	331	30	48	19	1371			

Note: Data in this table are based on Table XII of H. B. Chevery and T. Watanabe, op. cit., pp. 511-513.

TABLE B.4

INPUT-OUTPUT TABLE FOR THE NORWEGIAN ECONOMY

(Row and Column Totals in Million Kroner)

$a_{ij} \times 10^4$

Using Sectors / Producing Sectors	1	2	3	4	5	6	7	8	9	10	11	12
1	149	0	0	0	55	0	0	0	0	29	0	0
2	143	3037	0	0	0	0	8	9	0	0	0	1
3	0	0	451	0	31	0	0	0	0	4	0	0
4	0	102	723	0	0	0	0	0	0	0	0	0
5	0	0	403	0	65	0	0	0	0	0	0	0
6	269	484	161	401	24	784	617	782	606	244	453	382
7	54	3	0	0	0	0	199	2	0	4	58	11
8	0	0	0	0	0	0	0	2087	0	0	26	30
9	0	226	0	0	0	0	0	135	10	0	27	22
10	3881	337	0	0	31	12	31	87	1007	4296	44	25
11	0	0	0	0	0	10	0	419	0	8	1158	24
12	54	108	47	36	0	14	175	2178	10	0	1232	2283
13	0	3	49	2	0	6	0	36	0	0	158	22
14	6	13	65	0	0	42	214	348	0	1	141	102
15	12	318	590	99	0	25	381	116	480	204	82	78
16	0	0	0	0	0	0	0	0	0	0	0	0
17	80	1092	2918	0	9313	0	0	3	1556	1673	0	3
18	0	0	46	0	0	1	0	9	0	0	3	68
19	24	33	39	352	10	303	54	140	98	54	65	227
20	0	11	9	0	0	7	592	343	0	0	954	512
21	0	0	0	0	0	0	0	0	0	0	0	832
22	36	79	91	0	134	107	122	15	118	53	94	61
23	185	334	151	229	37	936	824	278	665	318	133	303
24	4	7	16	33	3	127	0	43	10	18	9	70
Interindustry Total (U_j) 25	246	241	1437	80	283	794	42	324	50	509	246	422
Total Production (X_j) 26	502	390	2494	696 690	292	6534	131	770	102	739	531	835
Imports(M_s)27	2	80	94	7	36	0	62	1016	37	567	474	461

Using Sectors / Producing Sectors	13	14	15	16	17	18	19	20	21	22	23	24	Total Intermediate Demand (W_i)	Final Demand	Total Demand
1	0	0	0	0	0	0	0	0	0	0	21	0	19	485	504
2	0	17	3	40	0	0	0	0	0	0	0	0	130	340	470
3	1	0	81	0	89	0	0	0	0	1	13	0	148	2440	2588
4	0	0	2102	0	29	0	0	0	0	0	5	0	465	238	703
5	0	0	0	0	589	0	0	0	0	0	0	0	222	106	328
6	604	365	352	199	322	219	643	439	115	268	463	2653	893	5641	3948
7	0	0	0	7	0	0	0	10	0	0	32	0	23	170	193
8	0	0	0	0	0	0	54	56	0	0	6	0	128	1658	1786
9	13	3	0	0	0	0	0	0	0	0	11	0	22	117	139
10	20	298	12	12	13	0	9	2	0	45	32	0	595	711	1306
11	2	1	0	0	0	0	0	23	0	0	19	0	94	911	1005
12	141	258	199	5	33	67	284	86	200	44	159	126	504	792	1296
13	474	34	20	0	10	0	189	5	0	26	24	0	57	249	306
14	173	1839	21	0	18	43	0	1	0	142	24	0	247	603	850
15	195	117	1972	83	700	306	97	264	196	214	117	190	723	834	1557
16	0	0	1	2483	0	0	0	0	0	2	290	0	217	208	425
17	21	1999	830	0	148	22	3	1	0	1610	36	0	1687	1101	2788
18	962	1	125	0	21	7	78	116	0	50	12	0	77	36	113
19	391	48	204	28	50	60	91	272	0	247	85	0	299	104	403
20	7	1	35	14	19	0	3	4189	0	25	13	0	320	337	657
21	0	0	9	0	0	0	0	1286	0	42	0	0	132	91	223
22	300	57	423	1038	6	0	1143	1	0	2400	78	0	506	684	1190
23	320	109	242	808	159	139	361	318	323	300	2419	0	1410	2843	4253
24	316	4	49	2	3	54	6277	19	35	91	78	316	110	19	129
Interindustry Total (U_j) 25	94	419	860	199	448	6	27	311	8	644	1320	11			
Total Production (X_j) 26	238	813	1299	421	2031	60	43	439	87	1156	4253	32			
Imports(M_s)27	68	37	258	4	757	53	360	218	136	34	0	97			

Note: Data in this table are based on Table XIII of H.B. Chenery and T. Watanabe, op. cit., pp. 514-516.

TABLE B.5

INPUT-OUTPUT TABLE FOR THE U.S. ECONOMY 1947
(Row and Column Totals in 10 Million Dollars)

$a_{ij} \times 10^4$

Using Sectors / Producing Sectors	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	Total Intermediate Demand (W_i)	Final Demand	Total Demand
1	1575	3	2	0	0	3	0	16	0	21	0	0	0	7	0	0	0	0	0	0	0	0	2	0	184	950	1134
2	45	2770	0	0	0	4	22	30	0	2	7	0	0	15	3	8	0	0	0	0	0	0	6	0	121	255	376
3	0	1180	1502	0	458	22	24	0	0	28	0	0	5	0	486	1	12	0	1	0	0	41	35	2	681	2819	3500
4	0	0	36	72	30	0	6	0	0	0	0	0	1	0	12	0	0	0	0	0	0	0	1	0	15	16	31
5	0	0	258	0	634	0	0	0	0	0	0	2	0	0	28	0	566	0	0	1	0	0	1	0	351	184	535
6	346	311	349	197	682	788	339	560	379	479	334	863	718	595	504	180	565	228	1625	1253	262	748	529	104	1576	4992	6568
7	160	42	8	336	2	83	587	167	0	25	61	42	17	18	39	49	4	0	2	7	0	10	90	0	203	490	693
8	0	0	4	322	4	290	10	2138	0	0	19	20	4	22	1	1	25	97	9	5	16	0	151	14	549	1136	1685
9	16	135	2	0	0	76	56	322	157	12	64	3	18	20	13	5	31	15	2	1	1	13	14	2	132	145	277
10	2752	250	5	729	345	20	402	342	1600	1894	26	5	86	150	64	38	22	0	1	1	0	83	12	0	707	405	1112
11	19	0	4	50	2	95	145	1936	0	32	1606	104	22	62	7	54	15	56	4	138	149	19	97	118	739	1903	2642
12	3	37	154	0	24	147	337	2303	91	6	1221	3093	106	210	118	1	23	207	136	255	202	32	41	109	1349	568	1917
13	0	17	73	0	0	14	52	136	12	2	85	91	551	69	74	0	6	16	58	42	23	11	35	0	144	268	412
14	0	64	30	21	0	38	104	228	0	26	103	33	46	2194	36	1	37	11	8	21	259	330	24	192	307	453	760
15	119	332	315	47	790	61	317	167	2178	742	172	88	252	98	2090	148	211	233	297	129	248	275	65	221	927	496	1423
16	0	0	12	0	0	76	1	0	0	2	8	4	0	0	12	1194	0	0	0	4	0	22	391	0	416	239	655
17	229	134	3880	0	4666	2	22	0	0	1830	0	0	0	260	901	0	2650	0	0	0	0	13	15	0	2998	1100	4098
18	0	0	1	0	1	356	66	0	13	0	2	25	454	0	144	0	10	136	9	9	0	25	1	5	54	48	102
19	5	8	26	243	11	187	22	63	52	32	36	493	410	122	243	11	110	193	2969	102	89	105	385	40	509	495	1004
20	0	2	12	0	0	7	304	256	0	9	484	331	19	4	128	22	0	14	0	3652	14	12	3	17	490	111	601
21	0	0	0	0	0	4	0	0	0	0	2	233	23	0	40	0	0	31	1	1114	0	0	0	0	116	5	121
22	41	151	148	0	46	52	212	31	72	54	50	37	661	11	260	1638	0	133	9	12	0	3571	24	1	618	162	780
23	43	267	306	333	252	1764	490	546	293	218	248	234	372	348	483	416	761	757	420	204	509	212	2151	565	2544	5344	7888
24	5	16	17	0	4	1043	11	20	41	28	14	32	174	9	77	3	1	42	7986	19	50	87	874	163	619	124	743
Interindustry Total (U_j) 25	627	213	2390	7	423	3240	240	1003	136	594	1196	1097	161	312	778	247	2030	19	720	394	16	406	1720	52			
Total Production (X_j) 26	1126	372	3346	28	534	4374	670	1682	277	1097	2636	1914	408	740	1356	654	4000	89	989	565	87	717	7876	720			
Imports (M_s) 27	8	4	154	3	1	2220	23	3	0	16	6	4	4	20	66	1	98	13	13	36	34	64	11	23			

Note: Data in this table are based on Table XIV of H.B. Chenery and T. Watanabe, op. cit., pp. 517-519.

(Table B.6 - Continued)

TABLE B.6

INPUT-OUTPUT TABLE FOR THE CANADIAN ECONOMY, 1949

(Row and Column Totals in Million of Canadian Dollars in 1949 Market Prices)

a_{ij}

Producing Sector \ Using Sector	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1	0.031	0.013	0.0	0.000	0.0	0.0	0.586	0.610	0.071	0.165	0.355	0.025	0.0	0.020	0.054	0.292	0.0	0.026
2	0.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	0.0	0.0	0.008	0.0	0.0	0.0	0.0	0.0	0.164	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	0.0	0.0	0.0	0.0	0.0	0.004	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.001	0.0
5	0.0	0.0	0.0	0.003	0.005	0.013	0.000	0.001	0.001	0.001	0.000	0.000	0.0	0.001	0.002	0.0	0.0	0.0
6	0.000	0.0	0.0	0.002	0.0	0.0	0.0	0.0	0.0	0.0	0.000	0.0	0.0	0.0	0.000	0.0	0.001	0.0
7	0.000	0.0	0.0	0.0	0.0	0.0	0.064	0.000	0.003	0.031	0.016	0.055	0.0	0.0	0.003	0.0	0.0	0.033
8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.026	0.001	0.004	0.002	0.014	0.0	0.0	0.015	0.0	0.0	0.0
9	0.0	0.0	0.0	0.0	0.0	0.0	0.004	0.001	0.010	0.008	0.015	0.026	0.058	0.089	0.020	0.0	0.0	0.001
10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.000	0.001	0.025	0.0	0.005	0.0	0.000	0.000	0.0	0.0	0.0
11	0.076	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.009	0.002	0.053	0.148	0.0	0.001	0.001	0.0	0.0	0.0
12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
13	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.063	0.0	0.0	0.0	0.0	0.0
14	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.001	0.003	0.002	0.0	0.0	0.025	0.0	0.0 *	0.0	0.0
15	0.000	0.0	0.0	0.0	0.0	0.0	0.000	0.006	0.011	0.052	0.003	0.050	0.112	0.004	0.053	0.0	0.0	0.000
16	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.240	0.0	0.0
17	0.007	0.000	0.0	0.002	0.002	0.002	0.001	0.001	0.001	0.0	0.0	0.002	0.008	0.002	0.000	0.001	0.006	0.006
18	0.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.003	0.205
19	0.005	0.004	0.031	0.001	0.0	0.0	0.0	0.0	0.0	0.0	0.011	0.0	0.0	0.0	0.007	0.0	0.124	0.006
20	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.002	0.010
21	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
22	0.000	0.001	0.008	0.012	0.0	0.012	0.001	0.002	0.002	0.003	0.0	0.0	0.006	0.004	0.0	0.004	0.0	0.013
23	0.001	0.0	0.0	0.000	0.0	0.012	0.003	0.011	0.019	0.033	0.031	0.048	0.020	0.043	0.033	0.032	0.005	0.010
24	0.0	0.0	0.0	0.000	0.003	0.002	0.001	0.002	0.004	0.004	0.004	0.004	0.005	0.003	0.004	0.002	0.003	0.002
25	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
26	0.015	0.034	0.004	0.017	0.009	0.010	0.013	0.011	0.025	0.112	0.003	0.001	0.027	0.017	0.005	0.009	0.011	0.016
27	0.007	0.012	0.025	0.016	0.019	0.049	0.002	0.004	0.002	0.005	0.002	0.006	0.002	0.005	0.003	0.002	0.006	0.003
28	0.0	0.0	0.019	0.000	0.0	0.0	0.000	0.000	0.001	0.0	0.000	0.000	0.0	0.000	0.000	0.0	0.001	0.000
29	0.0	0.0	0.0	0.008	0.0	0.0	0.001	0.001	0.001	0.003	0.001	0.001	0.0	0.003	0.002	0.001	0.004	0.002
30	0.000	0.0	0.003	0.004	0.0	0.0	0.001	0.008	0.005	0.040	0.000	0.001	0.0	0.012	0.0	0.0	0.0	0.001
31	0.044	0.033	0.041	0.013	0.012	0.023	0.004	0.009	0.010	0.006	0.003	0.019	0.034	0.013	0.007	0.006	0.013	0.004
32	0.016	0.000	0.003	0.021	0.005	0.007	0.016	0.002	0.003	0.001	0.020	0:006	0.012	0.002	0.003	0.004	0.050	0.003
33	0.021	0.014	0.0	0.008	0.015	0.017	0.003	0.004	0.003	0.003	0.002	0.005	0.027	0.001	0.003	0.002	0.003	0.003
34	0.050	0.027	0.036	0.041	0.020	0.053	0.129	0.079	0.103	0.106	0.307	0.103	0.057	0.044	0.044	0.051	0.054	0.057
35	0.0	0.0	0.0	0.002	0.001	0.003	0.003	0.005	0.009	0.002	0.006	0.009	0.009	0.004	0.005	0.001	0.012	0.008
36	0.002	0.000	0.001	0.047	0.024	0.014	0.002	0.004	0.004	0.003	0.005	0.008	0.003	0.006	0.003	0.002	0.007	0.003
37	0.032	0.003	0.011	0.010	0.011	0.014	0.005	0.008	0.018	0.014	0.007	0.023	0.024	0.020	0.014	0.016	0.044	0.014
38	0.000	0.0	0.0	0.008	0.005	0.006	0.003	0.005	0.016	0.022	0.018	0.021	0.044	0.025	0.012	0.034	0.022	0.009
Total Productivity X_j 39	2402.00	432.00	118.00	644.00	176.00	98.00	706.00	439.00	339.00	147.00	429.00	263.00	86.00	228.00	215.00	173.00	178.00	230.00

(Table B.6 - Continued)

(Table B.6 - Continued)

19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	Total Demand
0.003	0.004	0.001	0.021	0.015	0.0	0.0	0.000	0.0	0.000	0.0	0.002	0.0	0.039	0.001	0.001	0.0	0.0	0.000	0.010	2402.00
0.0	0.0	0.001	0.289	0.198	0.0	0.0	0.0	0.000	0.0	0.0	0.0	0.0	0.0	0.003	0.0	0.0	0.0	0.0	0.0	432.00
0.0	0.006	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.000	118.00
0.0	0.0	0.0	0.0	0.000	0.0	0.026	0.043	0.000	0.037	0.011	0.0	0.0	0.005	0.0	0.0	0.0	0.003	0.0	0.000	644.00
0.001	0.000	0.0	0.000	0.004	0.001	0.002	0.000	0.000	0.000	0.0	0.007	0.117	0.001	0.001	0.007	0.0	0.017	0.003	0.002	176.00
0.000	0.0	0.0	0.0	0.004	0.0	0.011	0.001	0.000	0.0	0.0	0.043	0.001	0.005	0.007	0.000	0.0	0.0	0.000	0.0	98.00
0.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.014	0.0	0.0	0.0	0.0	0.0	0.002	706.00
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.000	0.0	0.0	0.0	0.001	0.0	0.0	0.0	0.0	0.0	0.002	439.00
0.001	0.0	0.0	0.000	0.000	0.0	0.0	0.0	0.0	0.0	0.0	0.001	0.0	0.002	0.0	0.0	0.0	0.0	0.0	0.001	339.00
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.001	147.00
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.000	0.0	0.0	0.0	0.0	0.0	0.000	429.00
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.001	263.00
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.000	86.00
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.001	0.0	0.0	0.0	0.0	0.0	0.0	228.00
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.001	0.0	0.0	0.0	0.0	0.0	0.000	215.00
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	173.00
0.001	0.001	0.004	0.000	0.000	0.001	0.001	0.005	0.019	0.002	0.003	0.002	0.003	0.001	0.002	0.003	0.003	0.000	0.0	0.000	178.00
0.001	0.000	0.005	0.0	0.001	0.0	0.0	0.000	0.001	0.004	0.0	0.0	0.0	0.0	0.0	0.000	0.0	0.0	0.0	0.000	230.00
0.199	0.295	0.087	0.002	0.008	0.0	0.0	0.001	0.005	0.006	0.006	0.004	0.0	0.002	0.000	0.001	0.003	0.0	0.0	0.002	658.00
0.0	0.021	0.0	0.0	0.0	0.0	0.0	0.0	0.004	0.0	0.0	0.0	0.0	0.0	0.0	0.001	0.0	0.0	0.0	0.002	750.00
0.0	0.0	0.014	0.0	0.0	0.0	0.0	0.0	0.001	0.0	0.007	0.0	0.0	0.0	0.000	0.003	0.002	0.001	0.003	0.003	165.00
0.002	0.001	0.082	0.052	0.002	0.0	0.001	0.008	0.006	0.008	0.007	0.004	0.0	0.007	0.090	0.003	0.001	0.011	0.0	0.003	630.00
0.009	0.006	0.005	0.002	0.116	0.181	0.001	0.003	0.002	0.018	0.007	0.019	0.003	0.021	0.020	0.008	0.001	0.002	0.0	0.004	1091.00
0.001	0.003	0.002	0.001	0.002	0.074	0.001	0.002	0.001	0.003	0.002	0.002	0.001	0.004	0.001	0.008	0.014	0.002	0.010	0.048	176.00
0.0	0.0	0.0	0.0	0.000	0.0	0.092	0.107	0.042	0.002	0.017	0.005	0.0	0.001	0.013	0.0	0.0	0.000	0.0	0.000	321.00
0.004	0.001	0.045	0.012	0.011	0.001	0.007	0.081	0.076	0.008	0.088	0.012	0.005	0.015	0.100	0.005	0.002	0.007	0.0	0.011	1324.00
0.004	0.001	0.003	0.007	0.011	0.002	0.012	0.007	0.073	0.003	0.005	0.015	0.005	0.007	0.006	0.024	0.008	0.002	0.003	0.015	1135.00
0.000	0.006	0.001	0.000	0.000	0.001	0.0	0.000	0.005	0.045	0.002	0.001	0.000	0.001	0.002	0.004	0.003	0.001	0.000	0.009	227.00
0.003	0.001	0.002	0.004	0.008	0.001	0.007	0.006	0.027	0.002	0.053	0.013	0.004	0.005	0.031	0.002	0.021	0.013	0.002	0.003	484.00
0.000	0.0	0.0	0.0	0.002	0.0	0.003	0.001	0.006	0.000	0.004	0.039	0.0	0.009	0.041	0.002	0.001	0.001	0.0	0.001	247.00
0.002	0.001	0.007	0.010	0.013	0.006	0.093	0.010	0.009	0.014	0.007	0.034	0.045	0.031	0.010	0.012	0.013	0.019	0.005	0.007	556.00
0.015	0.002	0.015	0.006	0.011	0.015	0.002	0.003	0.007	0.015	0.011	0.009	0.003	0.082	0.027	0.001	0.000	0.016	0.0	0.007	590.00
0.006	0.003	0.004	0.008	0.008	0.004	0.017	0.008	0.005	0.004	0.004	0.006	0.005	0.007	0.001	0.043	0.036	0.053	0.127	0.049	2979.00
0.030	0.029	0.075	0.100	0.059	0.043	0.076	0.069	0.048	0.058	0.053	0.077	0.084	0.076	0.158	0.043	0.070	0.028	0.011	0.047	4477.00
0.004	0.010	0.012	0.007	0.008	0.017	0.002	0.006	0.003	0.014	0.008	0.003	0.004	0.008	0.003	0.006	0.091	0.001	0.006	0.012	327.00
0.007	0.003	0.006	0.005	0.022	0.005	0.036	0.006	0.004	0.004	0.005	0.023	0.006	0.014	0.004	0.005	0.004	0.189	0.007	0.015	489.00
0.012	0.012	0.019	0.014	0.016	0.031	0.007	0.018	0.010	0.030	0.016	0.019	0.029	0.024	0.017	0.033	0.018	0.003	0.098	0.018	2119.00
0.004	0.006	0.012	0.007	0.008	0.015	0.004	0.011	0.006	0.019	0.013	0.007	0.008	0.025	0.016	0.028	0.028	0.003	0.032	0.033	3545.00
38.00	756.00	165.00	630.00	1091.00	376.00	321.00	1324.00	1135.00	227.00	484.00	247.00	556.00	590.00	2979.00	4477.00	327.00	489.00	2119.00	3545.00	

TABLE B.7

INPUT-OUTPUT TABLE FOR THE CANADIAN ECONOMY, 1961
(Row and Column Totals in Million of Canadian Dollars in 1961 Market Prices)
a_{ij}

(Table B.7 - Continued)

Producing Sector \ Using Sector	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	0.011	0.011	0.001	0.0	0.005	0.0	0.486	0.483	0.124	0.148	0.372	0.007	0.001	0.037
2	0.003	0.101	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.001	0.0	0.001	0.001
3	0.0	0.0	0.012	0.0	0.0	0.0	0.0	0.0	0.113	0.0	0.001	0.0	0.0	0.0
4	0.0	0.0	0.0	0.324	0.001	0.001	0.0	0.0	0.0	0.001	0.0	0.0	0.0	0.0
5	0.001	0.0	0.0	0.008	0.017	0.009	0.0	0.001	0.001	0.002	0.0	0.001	0.001	0.001
6	0.0	0.0	0.001	0.002	0.001	0.004	0.0	0.0	0.001	0.001	0.001	0.001	0.0	0.0
7	0.001	0.0	0.0	0.0	0.0	0.0	0.123	0.001	0.013	0.030	0.021	0.031	0.001	0.002
8	0.0	0.0	0.0	0.0	0.0	0.0	0.001	0.067	0.005	0.006	0.003	0.012	0.001	0.0
9	0.003	0.0	0.0	0.0	0.0	0.0	0.018	0.006	0.062	0.012	0.055	0.038	0.007	0.041
10	0.0	0.0	0.0	0.0	0.0	0.0	0.001	0.002	0.004	0.043	0.001	0.018	0.0	0.001
11	0.079	0.007	0.0	0.0	0.0	0.0	0.001	0.0	0.015	0.001	0.066	0.127	0.0	0.007
12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.001	0.0	0.0
13	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.102	0.0
14	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.001	0.0	0.003	0.0	0.001	0.035
15	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.005	0.012	0.028	0.008	0.035	0.069	0.002
16	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
17	0.002	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
18	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
19	0.003	0.001	0.021	0.0	0.0	0.004	0.001	0.0	0.002	0.0	0.012	0.0	0.0	0.0
20	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
21	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
22	0.002	0.001	0.010	0.0	0.001	0.002	0.001	0.001	0.002	0.0	0.0	0.0	0.0	0.006
23	0.001	0.0	0.001	0.0	0.0	0.020	0.015	0.024	0.037	0.042	0.023	0.063	0.008	0.037
24	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.001	0.005	0.010
25	0.0	0.0	0.0	0.007	0.0	0.0	0.0	0.0	0.002	0.001	0.001	0.0	0.0	0.0
26	0.009	0.008	0.016	0.014	0.012	0.008	0.003	0.008	0.012	0.085	0.005	0.001	0.022	0.016
27	0.001	0.001	0.010	0.001	0.001	0.001	0.001	0.001	0.001	0.003	0.001	0.001	0.001	0.001
28	0.0	0.0	0.005	0.001	0.0	0.001	0.0	0.001	0.001	0.002	0.001	0.001	0.001	0.001
29	0.001	0.001	0.006	0.001	0.001	0.001	0.0	0.0	0.001	0.003	0.001	0.001	0.001	0.001
30	0.0	0.0	0.001	0.003	0.0	0.001	0.0	0.003	0.006	0.022	0.0	0.0	0.002	0.031
31	0.044	0.024	0.041	0.005	0.008	0.026	0.001	0.007	0.004	0.003	0.002	0.011	0.009	0.005
32	0.021	0.002	0.003	0.011	0.005	0.017	0.005	0.004	0.022	0.009	0.011	0.021	0.014	0.005
33	0.019	0.023	0.050	0.009	0.014	0.009	0.002	0.003	0.003	0.003	0.002	0.003	0.004	0.005
34	0.056	0.051	01058	0.022	0.024	0.041	0.067	0.026	0.062	0.064	0.125	0.064	0.031	0.044
35	0.004	0.004	0.002	0.001	0.005	0.003	0.003	0.003	0.004	0.005	0.003	0.003	0.005	0.004
36	0.008	0.002	0.001	0.023	0.018	0.023	0.005	0.006	0.006	0.006	0.007	0.008	0.006	0.010
37	0.029	0.078	0.017	0.007	0.165	0.017	0.002	0.008	0.009	0.011	0.006	0.018	0.018	0.009
38	0.035	0.148	0.002	0.038	0.092	0.115	0.031	0.054	0.084	0.082	0.046	0.074	0.128	0.149
Interindustry Total (U_j)	1142.000	380.310	33.256	1201.500	324.340	82.840	982.980	654.520	421.850	205.600	205.600	439.960	249.730	77.00
Total Production(X_j)	3120.10	821.00	128.90	2518.80	876.60	273.400	1281.600	916.700	692.700	335.400	565.500	461.600	175.400	435.800

(Table B.7 - Continued)

(Table B.7 - Continued)

15	16	17	18	19	20	21	22	23
0.060	0.275	0.001	0.002	0.004	0.009	0.001	0.020	0.011
0.0	0.0	0.0	0.0	0.0	0.0	0.002	0.272	0.141
0.0	0.0	0.0	0.0	0.0	0.011	0.0	0.0	0.0
0.0	0.0	0.005	0.0	0.001	0.0	0.002	0.0	0.001
0.002	0.0	0.003	0.001	0.002	0.0	0.001	0.0	0.007
0.001	0.0	0.001	0.0	0.0	0.0	0.0	0.0	0.003
0.001	0.004	0.001	0.061	0.0	0.0	0.0	0.0	0.0
0.014	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.015	0.0	0.002	0.003	0.005	0.001	0.0	0.001	0.002
0.002	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.001	0.0	0.0
0.072	0.001	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.220	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.022	0.031	0.005	0.003	0.016	0.0	0.0
0.0	0.0	0.007	0.175	0.0	0.001	0.002	0.0	0.0
0.003	0.0	0.065	0.022	0.199	0.223	0.058	0.001	0.006
0.0	0.0	0.003	0.005	0.013	0.077	0.001	0.0	0.0
0.0	0.0	0.0	0.0	0.001	0.001	0.023	0.003	0.001
0.0	0.003	0.001	0.003	0.002	0.0	0.073	0.111	0.019
0.055	0.070	0.012	0.016	0.019	0.011	0.019	0.003	0.127
0.001	0.003	0.0	0.0	0.0	0.0	0.001	0.0	0.003
0.0	0.0	0.001	0.001	0.0	0.0	0.012	0.001	0.001
0.003	0.003	0.011	0.007	0.003	0.001	0.049	0.006	0.007
0.001	0.001	0.002	0.001	0.001	0.001	0.002	0.001	0.001
0.001	0.006	0.005	0.017	0.004	0.015	0.016	0.001	0.003
0.001	0.0	0.001	0.001	0.001	0.001	0.007	0.001	0.001
0.001	0.0	0.001	0.001	0.001	0.0	0.007	0.003	0.002
0.004	0.001	0.003	0.001	0.004	0.001	0.002	0.008	0.010
0.011	0.0	0.117	0.022	0.043	0.004	0.014	0.010	0.024
[illegible]	0.004	0.003	0.002	0.005	0.001	0.003	0.006	0.004
[illegible]	0.026	0.041	0.071	0.049	0.058	0.074	0.075	0.048
[illegible]	0.002	0.006	0.005	0.004	0.004	0.007	0.004	0.004
[illegible]	0.002	0.010	0.005	0.009	0.003	0.006	0.010	0.031
0.011	0.013	0.017	0.012	0.012	0.021	0.018	0.013	0.010
0.063	0.074	0.071	0.086	0.056	0.042	0.051	0.052	0.054
200.000	237.180	139.870	162.710	391.660	507.580	171.430	637.940	1161.000
[illegible]4.600	[illegible]35.00	339.500	295.300	884.100	1038.000	366.300	1059.700	2228.500

24	25	26	27	28	29	30	31	32
0.001	0.0	0.0	0.0	0.001	0.001	0.0	0.0	0.001
0.0	0.001	0.0	0.0	0.0	0.0	0.001	0.0	0.001
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.152	[illegible]	0.004	0.027	0.015	0.012	0.007	0.006
0.0	0.033	[illegible]	0.001	0.001	0.001	0.008	0.326	0.006
0.0	0.004	[illegible]	0.0	0.0	0.0	0.038	0.001	0.009
0.0	0.0	[illegible]	0.0	0.001	0.0	0.0	0.0	0.003
0.0	0.0	[illegible]	0.0	0.0	0.0	0.0	0.0	0.001
0.0	0.001	[illegible]	0.0	0.001	0.0	0.001	0.001	0.017
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.001
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.001
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.002	0.019	0.002	0.010	0.001	0.0	0.002
0.0	0.0	0.0	0.0	0.003	0.0	0.0	0.0	0.0
0.004	0.0	0.0	0.009	0.011	0.002	0.003	0.0	0.003
0.0	0.0	0.0	0.0	0.001	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.001	0.001	0.007	0.0	0.0	0.0
0.001	0.002	0.003	0.002	0.016	0.002	0.002	0.0	0.001
0.165	0.002	0.005	0.003	0.024	0.009	0.023	0.001	0.027
0.004	0.0	0.001	0.0	0.001	0.0	0.0	0.0	0.0
0.0	0.043	0.134	0.027	0.011	0.027	0.004	0.0	0.003
0.004	0.020	0.106	0.056	0.040	0.086	0.009	0.006	0.013
0.001	0.001	0.005	0.188	0.003	0.005	0.001	0.001	0.002
0.002	0.001	0.003	0.008	0.025	0.007	0.003	0.002	0.006
0.0	0.001	0.015	0.015	0.008	0.114	0.002	0.001	0.001
0.0	0.016	0.003	0.010	0.011	0.007	0.002	0.0	0.009
0.002	0.012	0.003	0.002	0.003	0.002	0.013	0.010	0.029
0.012	0.005	0.007	0.007	0.072	0.017	0.017	0.026	0.137
0.003	0.005	0.005	0.006	0.004	0.003	0.007	0.021	0.007
0.027	0.059	0.042	0.049	0.039	0.038	0.077	0.090	0.053
0.021	0.003	0.008	0.005	0.009	0.009	0.006	0.001	0.007
0.005	0.026	0.008	0.005	0.006	0.006	0.031	0.008	0.024
0.019	0.004	0.015	0.006	0.025	0.022	0.014	0.009	0.015
0.081	0.078	0.060	0.054	0.103	0.062	0.107	0.017	0.111
360.42	369.100	14 .300	927.860	291.22	583.08	328.890	655.930	742.810
874.800	787.00	28 .00	1945.200	648.60	1290.00	696.80	1242.300	1497.60

33	34	35	36	37	38	Total Inter-mediate Demand (W_i)	Total Demand
0.002	0.019	0.0	0.001	0.002	0.009	2051.20	3120.1
0.003	0.001	0.0	0.0	0.0	0.001	738.71	821.4
0.0	0.0	0.0	0.0	0.0	0.0	91.805	128.9
0.001	0.0	0.0	0.001	0.0	0.001	1209.700	2518.8
0.0	0.001	0.0	0.004	0.0	0.0	531.530	876.6
0.007	0.0	0.0	0.0	0.0	0.0	112.830	273.4
0.0	0.0	0.0	0.0	0.0	0.015	343.460	1281.6
0.0	0.001	0.0	0.0	0.0	0.013	187.210	916.7
0.0	0.0	0.0	0.0	0.0	0.005	234.920	692.7
0.0	0.0	0.0	0.0	0.0	0.005	66.959	335.4
0.0	0.001	0.0	0.0	0.0	0.002	390.910	565.5
0.0	0.0	0.0	0.0	0.0	0.008	59.603	461.6
0.0	0.0	0.0	0.0	0.0	0.003	39.966	175.4
0.0	0.0	0.0	0.0	0.0	0.004	49.115	435.8
0.0	0.0	0.0	0.0	0.0	0.002	90.764	274.6
0.0	0.0	0.0	0.0	0.0	0.0	73.700	335.0
0.003	0.003	0.0	0.0	0.0	0.010	223.360	339.5
0.0	0.0	0.0	0.0	0.0	0.001	65.129	295.3
0.005	0.003	0.001	0.0	0.0	0.004	630.740	884.1
0.0	0.002	0.0	0.0	0.0	0.001	123.540	1038.0
0.003	0.0	0.0	0.0	0.0	0.0	48.430	366.3
0.051	0.001	0.0	0.001	0.0	0.002	621.950	1059.7
0.010	0.008	0.0	0.001	0.0	0.010	999.010	2228.5
0.0	0.001	0.007	0.0	0.001	0.065	576.870	874.8
0.015	0.001	0.0	0.001	0.0	0.001	672.660	787.0
0.100	0.003	0.001	0.001	0.001	0.033	1785.600	2866.0
0.005	0.005	0.001	0.0	0.0	0.011	587.28	1945.0
0.006	0.001	0.001	0.0	0.0	0.010	242.01	648.6
0.032	0.001	0.007	0.0	0.0	0.010	566.39	1290.0
0.053	0.0	0.0	0.0	0.0	0.002	569.12	696.8
0.013	0.023	0.002	0.006	0.001	0.004	723.85	1242.3
0.008	0.001	0.0	0.0	0.001	0.021	907.70	1497.6
0.001	0.020	0.032	0.045	0.077	0.003	1081.20	7017.1
0.100	0.061	0.061	0.009	0.004	0.121	3937.10	10627.8
0.003	0.021	0.022	0.004	0.009	0.020	635.80	1123.6
0.001	0.010	0.003	0.187	0.003	0.003	769.09	1262.4
0.009	0.045	0.013	0.024	0.054	0.027	1755.30	6552.9
0.041	0.089	0.058	0.027	0.061	0.139	4713.50	7358.3
3312.100	3422.100	234.830	393.87	1402.300	4164.800		
7017.100	10627.80	1123.600	1262.40	6552.900	7358.300		

TABLE B.8

INPUT-OUTPUT TABLE FOR THE CANADIAN ECONOMY
1949 ADJUSTED FOR 1961 PRICES

(Row and Column Totals in Million of Canadian Dollars in 1961 Market Prices)

Using Sector / Producing Sector	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	0.031	0.014	0.0	0.000	0.0	0.0	0.370	0.358	0.049	0.129	0.244	0.017	0.0	0.017
2	0.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	0.0	0.0	0.008	0.0	0.0	0.0	0.0	0.0	0.126	0.0	0.0	0.0	0.0	0.0
4	0.0	0.0	0.0	0.0	0.0	0.004	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	0.0	0.0	0.0	0.002	0.005	0.010	0.000	0.001	0.000	0.000	0.000	0.000	0.0	0.001
6	0.001	0.0	0.0	0.002	0.0	0.0	0.0	0.0	0.0	0.0	0.000	0.0	0.0	0.0
7	0.000	0.0	0.0	0.0	0.0	0.0	0.064	0.000	0.004	0.038	0.018	0.058	0.0	0.0
8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.026	0.001	0.005	0.002	0.016	0.0	0.0
9	0.0	0.0	0.0	0.0	0.0	0.0	0.003	0.001	0.010	0.009	0.015	0.025	0.042	0.110
10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.000	0.001	0.025	0.0	0.004	0.0	0.000
11	0.111	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.009	0.002	0.053	0.143	0.0	0.001
12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
13	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.063	0.0
14	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.001	0.003	0.001	0.0	0.0	0.025
15	0.000	0.0	0.0	0.0	0.0	0.0	0.000	0.005	0.011	0.061	0.003	0.050	0.083	0.006
16	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
17	0.012	0.000	0.0	0.002	0.004	0.003	0.001	0.001	0.002	0.0	0.0	0.003	0.007	0.003
18	0.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
19	0.004	0.004	0.025	0.001	0.0	0.0	0.0	0.0	0.0	0.0	0.007	0.0	0.0	0.0
20	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
21	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
22	0.000	0.001	0.008	0.010	0.0	0.011	0.001	0.001	0.001	0.003	0.0	0.0	0.003	0.003
23	0.001	0.0	0.0	0.000	0.0	0.016	0.003	0.010	0.022	0.042	0.035	0.051	0.016	0.060
24	0.0	0.0	0.0	0.001	0.005	0.002	0.001	0.002	0.004	0.005	0.004	0.004	0.003	0.003
25	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
26	0.027	0.062	0.007	0.024	0.017	0.014	0.014	0.012	0.030	0.152	0.003	0.001	0.023	0.026
27	0.009	0.016	0.027	0.016	0.026	0.048	0.002	0.003	0.002	0.005	0.002	0.005	0.001	0.005
28	0.0	0.0	0.021	0.000	0.0	0.0	0.000	0.000	0.001	0.0	0.000	0.000	0.0	0.000
29	0.0	0.0	0.0	0.008	0.0	0.0	0.001	0.001	0.001	0.003	0.001	0.001	0.0	0.003
30	0.000	0.0	0.003	0.004	0.0	0.0	0.001	0.006	0.004	0.039	0.000	0.001	0.0	0.013
31	0.052	0.041	0.043	0.012	0.016	0.022	0.003	0.006	0.008	0.006	0.003	0.015	0.019	0.013
32	0.020	0.000	0.003	0.021	0.007	0.007	0.013	0.001	0.002	0.001	0.017	0.005	0.007	0.002
33	0.028	0.020	0.0	0.009	0.022	0.019	0.002	0.003	0.003	0.004	0.002	0.004	0.018	0.002
34	0.063	0.037	0.041	0.041	0.028	0.054	0.103	0.059	0.091	0.105	0.267	0.086	0.036	0.048
35	0.0	0.0	0.0	0.003	0.003	0.006	0.005	0.006	0.014	0.004	0.009	0.013	0.010	0.009
36	0.002	0.000	0.001	0.038	0.026	0.011	0.001	0.002	0.002	0.003	0.004	0.006	0.002	0.005
37	0.065	0.006	0.021	0.017	0.024	0.024	0.006	0.009	0.026	0.023	0.010	0.031	0.025	0.036
38	0.000	0.0	0.0	0.012	0.009	0.009	0.004	0.005	0.021	0.032	0.023	0.026	0.041	0.041
Interindustry Total (U_j)	969.93	77.284	25.543	170.590	29.351	30.021	631.110	368.040	205.780	123.940	426.840	210.580	65.478	108.040
Total Production (X_j)	2270.322	384.684	123.045	761.229	152.249	116.251	1056.886	708.064	460.598	179.751	590.096	374.111	163.498	249.726

15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	Total Inter-mediate Demand (W_i)	Total Demand	Index of Prices 1949 (1961=100)
0.036	0.286	0.0	0.025	0.003	0.004	0.000	0.019	0.009	0.0	0.0	0.000	0.0	0.000	0.0	0.002	0.0	0.031	0.001	0.001	0.0	0.0	0.000	0.005	1079.00	2270.32	105.8
0.0	0.0	0.0	0.0	0.0	0.0	0.000	0.248	0.115	0.0	0.0	0.0	0.000	0.0	0.0	0.0	0.0	0.0	0.002	0.0	0.0	0.0	0.0	0.0	361.53	384.68	112.3
0.0	0.0	0.0	0.0	0.0	0.007	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.000	64.65	123.05	95.9
0.0	0.0	0.000	0.0	0.0	0.0	0.0	0.0	0.000	0.0	0.022	0.031	0.000	0.037	0.010	0.0	0.0	0.005	0.0	0.0	0.0	0.003	0.0	0.000	101.65	761.23	84.6
0.001	0.0	0.0	0.0	0.001	0.000	0.0	0.000	0.002	0.000	0.002	0.000	0.000	0.000	0.0	0.005	0.092	0.000	0.000	0.005	0.0	0.015	0.001	0.001	114.10	152.25	115.6
0.000	0.0	0.000	0.0	0.000	0.0	0.0	0.0	0.003	0.0	0.009	0.001	0.000	0.0	0.0	0.042	0.001	0.005	0.006	0.000	0.0	0.0	0.000	0.0	57.29	116.25	84.3
0.003	0.0	0.0	0.051	0.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.018	0.0	0.0	0.0	0.0	0.0	0.002	146.26	1056.89	66.8
0.017	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.001	0.0	0.0	0.0	0.001	0.0	0.0	0.0	0.0	0.0	0.002	42.74	708.06	62.0
0.019	0.0	0.0	0.001	0.001	0.0	0.0	0.000	0.000	0.0	0.0	0.0	0.0	0.0	0.0	0.001	0.0	0.002	0.0	0.0	0.0	0.0	0.0	0.001	75.81	460.59	73.6
0.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.000	9.55	177.75	82.7
0.001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.009	0.0	0.0	0.0	0.0	0.0	0.000	345.25	590.10	72.7
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.001	5.83	374.11	70.3
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.000	12.16	163.50	52.6
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.001	0.0	0.0	0.0	0.0	0.0	0.0	8.76	249.73	91.3
0.053	0.0	0.0	0.001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.001	0.0	0.0	0.0	0.0	0.0	0.000	75.18	304.97	70.5
0.0	0.240	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	40.14	167.31	103.4
0.001	0.001	0.006	0.009	0.003	0.001	0.005	0.000	0.000	0.001	0.001	0.005	0.025	0.002	0.004	0.002	0.004	0.001	0.002	0.004	0.002	0.001	0.0	0.000	126.60	278.56	63.9
0.0	0.0	0.002	0.205	0.001	0.000	0.004	0.0	0.001	0.0	0.0	0.000	0.001	0.003	0.0	0.0	0.0	0.0	0.0	0.000	0.0	0.0	0.0	0.000	54.07	225.71	101.9
0.004	0.0	0.068	0.005	0.199	0.269	0.060	0.001	0.004	0.0	0.0	0.000	0.004	0.004	0.005	0.003	0.0	0.001	0.000	0.001	0.001	0.0	0.0	0.001	385.59	550.48	115.6
0.0	0.0	0.001	0.010	0.0	0.021	0.0	0.0	0.0	0.0	0.0	0.0	0.003	0.0	0.0	0.0	0.0	0.0	0.0	0.000	0.0	0.0	0.0	0.001	30.02	715.91	105.6
0.0	0.0	0.0	0.0	0.0	0.0	0.014	0.0	0.0	0.0	0.0	0.0	0.001	0.0	0.007	0.0	0.0	0.0	0.000	0.003	0.001	0.001	0.002	0.002	49.31	208.59	79.1
0.0	0.004	0.0	0.013	0.003	0.001	0.067	0.052	0.001	0.0	0.001	0.005	0.006	0.007	0.006	0.004	0.0	0.006	0.073	0.003	0.000	0.012	0.0	0.002	412.02	652.85	96.5
0.036	0.051	0.008	0.016	0.015	0.009	0.006	0.003	0.116	0.198	0.001	0.003	0.003	0.023	0.009	0.024	0.004	0.027	0.024	0.011	0.001	0.003	0.0	0.004	655.33	1663.11	65.6
0.004	0.003	0.003	0.003	0.002	0.004	0.003	0.001	0.002	0.074	0.001	0.001	0.001	0.004	0.002	0.002	0.002	0.004	0.001	0.009	0.009	0.002	0.007	0.038	404.60	524.41	71.7
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.000	0.0	0.092	0.089	0.050	0.002	0.019	0.006	0.0	0.001	0.014	0.0	0.0	0.000	0.0	0.000	368.13	439.13	73.1
0.006	0.016	0.011	0.026	0.008	0.002	0.059	0.019	0.011	0.001	0.008	0.081	0.106	0.012	0.121	0.016	0.008	0.021	0.128	0.007	0.002	0.011	0.0	0.010	1256.90	2163.40	61.2
0.003	0.003	0.005	0.003	0.006	0.002	0.003	0.008	0.008	0.001	0.010	0.005	0.073	0.003	0.004	0.015	0.005	0.007	0.006	0.023	0.004	0.003	0.002	0.010	436.13	1322.84	85.8
0.000	0.0	0.000	0.001	0.000	0.007	0.001	0.000	0.000	0.000	0.0	0.000	0.005	0.045	0.002	0.001	0.000	0.001	0.002	0.004	0.002	0.001	0.000	0.006	100.71	269.92	84.1
0.002	0.001	0.003	0.002	0.004	0.001	0.002	0.005	0.006	0.001	0.006	0.005	0.027	0.002	0.053	0.013	0.004	0.005	0.029	0.002	0.012	0.017	0.001	0.002	271.50	574.82	84.2
0.0	0.0	0.0	0.001	0.000	0.0	0.0	0.0	0.002	0.0	0.003	0.001	0.006	0.000	0.004	0.039	0.0	0.009	0.039	0.002	0.000	0.001	0.0	0.001	218.17	293.35	84.2
0.006	0.007	0.009	0.004	0.003	0.001	0.006	0.010	0.010	0.005	0.075	0.007	0.009	0.013	0.006	0.032	0.045	0.028	0.009	0.011	0.006	0.022	0.003	0.004	482.98	610.32	91.1
0.003	0.005	0.038	0.003	0.021	0.002	0.014	0.007	0.009	0.013	0.002	0.002	0.008	0.015	0.011	0.009	0.003	0.082	0.025	0.001	0.000	0.020	0.0	0.004	374.76	705.74	83.6
0.003	0.003	0.003	0.004	0.008	0.003	0.004	0.010	0.007	0.003	0.016	0.006	0.005	0.005	0.004	0.007	0.006	0.007	0.061	0.046	0.022	0.072	0.083	0.035	1032.80	3790.08	78.2
0.037	0.064	0.042	0.082	0.049	0.037	0.071	0.115	0.046	0.037	0.067	0.050	0.050	0.058	0.054	0.077	0.092	0.077	0.148	0.043	0.039	0.035	0.007	0.032	2364.70	5361.68	83.5
0.007	0.001	0.017	0.018	0.009	0.022	0.020	0.015	0.011	0.026	0.003	0.008	0.006	0.025	0.015	0.005	0.007	0.015	0.005	0.011	0.091	0.002	0.007	0.015	432.55	700.22	46.7
0.002	0.002	0.004	0.003	0.008	0.003	0.005	0.005	0.014	0.003	0.025	0.004	0.003	0.003	0.004	0.018	0.005	0.011	0.003	0.004	0.002	0.189	0.003	0.008	316.94	465.27	105.1
0.019	0.032	0.055	0.029	0.027	0.025	0.029	0.027	0.020	0.043	0.011	0.022	0.016	0.048	0.027	0.031	0.051	0.040	0.026	0.053	0.016	0.005	0.098	0.019	1474.60	4138.67	51.2
0.015	0.062	0.026	0.016	0.007	0.011	0.017	0.012	0.010	0.019	0.005	0.013	0.009	0.029	0.019	0.011	0.013	0.037	0.022	0.042	0.023	0.006	0.029	0.033	905.35	6319.07	50.1
85.033	130.470	84.011	120.040	209.340	309.250	81.008	364.430	680.900	223.580	157.670	731.65	550.930	91.778	222.350	106.960	208.770	312.910	2155.500	1539.100	164.060	195.670	1008.900	1516.800			
304.966	167.311	278.560	225.712	550.475	715.909	208.597	652.850	1663.110	524.407	439.125	2163.399	1322.844	269.917	574.822	293.349	610.318	705.741	3790.070	5361.676	700.214	564.271	4138.670	6319.070			